

DESIGN GUIDELINE FOR UTM ACADEMICIAN PERSONAL RESEARCH
AND PUBLICATION DASHBOARD

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To my beloved parents,
Mr. Harun Bin Nahudah and Mrs Persia Buklaw Samsu,
and my precious sibling.

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ABSTRACT

The dashboard displayed the organization's important information on a single screen which enables them to monitor their performance and make necessary decisions. However, the biggest issue that a dashboard has is it does not have specific design guideline for the developer to follow. Addressing this issue, this study is executed to find a suitable dashboard design guideline and use it to design a dashboard for the academicians from Universiti Teknologi Malaysia (UTM). The purpose of this study is to identify dashboard design guideline for UTM APRPD, visualization features to be included in the UTM APRPD, and to validate the dashboard design guideline identified. UTM Academician Personal Research and Publication Dashboard (UTM APRPD) is a dashboard designed to monitor and analyze UTM academician's individual performance in publication and research grant performance. This study is using the Research and Development Information System (RADIS) as its case study. The dashboard design guideline used to design the UTM APRPD was validated by analyzing the result obtained from the interview session with the respondents. In contrast to the RADIS, UTM APRPD interface design was improved to visually aid the academicians in monitoring their performance. The academicians agree that the dashboard was designed fine and are relevant to be used. Thus, the dashboard design guidelines identified in this study can be used to design the UTM APRPD.

ABSTRAK

Dashboard merupakan salah satu aplikasi *Business Intelligence* (BI) yang telah digunakan secara meluas dalam industri yang berbeza bagi tujuan yang berbeza. *Dashboard* memaparkan maklumat penting sesebuah organisasi pada satu skrin yang membolehkan mereka memantau prestasi dan membuat perancangan yang diperlukan. Walau, dashboard tidak mempunyai garis panduan reka bentuk yang khusus untuk digunakan oleh pereka sistem. Kajian ini dijalankan untuk mencari garis panduan reka bentuk *dashboard* yang sesuai dan menggunakannya untuk mereka bentuk papan pemuka untuk ahli akademik dari Universiti Teknologi Malaysia (UTM). Terdapat tiga matlamat yang ingin dicapai dalam kajian ini iaitu bago mengenalpasti garis panduan reka bentuk untuk UTM APRPD, untuk mengenalpasti ciri visualisasi yang boleh digunakan oleh UTM APRPD, dan untuk mengesahkan garis panduan reka bentuk *dashboard* yang telah dikenal pasti. UTM *Academician Personal Research and Publication Dashboard* (UTM APRPD) merupakan sebuah *dashboard* yang direka bagi memantau dan menganalisis prestasi individu ahli akademik dari UTM dalam penerbitan dan geran penyelidikan. Kajian ini menggunakan *Research and Development Information System* (RADIS) sebagai kajian kesnya. Garis panduan reka bentuk papan pemuka yang digunakan untuk merekabentuk UTM APRPD telah disahkan dengan menganalisis hasil sesi wawancara yang telah dijalankan. Berbeza dengan RADIS, reka bentuk antara muka UTM APRPD ditambah baik untuk membantu para ahli akademik dalam memantau prestasi mereka. Kesemua responden bersetuju untuk menggunakan UTM APRPD, ini menunjukkan bahawa ianya telah direka dengan baik dan relevan untuk digunakan. Oleh itu, garis panduan reka bentuk papan pemuka yang dikenal pasti untuk kajian ini boleh digunakan untuk merekabentuk UTM APRPD.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF ABBREVIATIONS	xiii
	LIST OF APPENDICES	xiv
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Research Background	2
	1.3 Problem Statement	5
	1.4 Research Questions	6
	1.5 Research Objectives	6
	1.6 Scope of the Study	7
	1.7 Significant of the Study	7
	1.8 Thesis Structure	7
2	LITERATURE REVIEW	9
	2.1 Introduction	9
	2.2 Dashboard	9

2.2.1	Dashboard Characteristics	13
2.2.2	Dashboard Development Process	14
2.2.3	Dashboard Design Guideline	17
2.2.4	Dashboard Type	26
2.2.5	Dashboard Purposes and Features	32
2.3	Data Visualization	35
2.3.1	Visual Features	36
2.3.2	Functional Features	39
2.3.3	Things to Avoid	43
2.4	Personal Information Management	45
2.5	Key Performance Indicator	46
2.6	Summary	48
3	RESEARCH METHODOLOGY	50
3.1	Introduction	50
3.2	Research Methodology	50
3.2.1	Phase 1: Problem Formulation	52
3.2.2	Phase 2: Literature Review	53
3.2.3	Phase 3: Dashboard Type Selection	54
3.2.4	Phase 4: Prototype Design	55
3.2.5	Phase 5: Impact Evaluation	55
3.3	Summary	56
4	UTM APRPD MOCK-UP PROTOTYPE DESIGN	57
4.1	Introduction	57
4.2	Study on RADIS	58
4.2.1	Research Grant Module	58
4.2.2	Publication Module	59
4.2.3	Key Amal Indicator (KAI) Module	60
4.2.4	Discussion	61
4.3	UTM APRPD Mock-Up Prototype	62
4.3.1	Dashboard's Information Content	63
4.3.2	Dashboard's Information Design	68

4.4	Conclusion	82
5	DASHBOARD DESIGN GUIDELINE VALIDATION PHASE	84
5.1	Introduction	84
5.2	Interview Session	85
5.3	Interview Result	86
5.3.1	Dashboard's Information Content Analysis	86
5.3.2	Dashboard's Information Design Analysis	87
5.4	Discussion	90
5.5	Summary	93
6	CONCLUSION	94
6.1	Introduction	94
6.2	Overall Achievements	94
6.2.1	The First Research Objective of the Study	95
6.2.2	The Second Research Objective of the Study	95
6.2.3	The Third Research Objective of the Study	95
6.3	Contribution of the Study	96
6.4	Limitation of the Study	97
6.5	Conclusion	97
	REFERENCE	99
	Appendices A - E	104

LIST OF TABLES

TABLE NO.	TITLE	PAGE
2.1	Comparisons of Dashboard, Portals, and Balance Scorecards (Malik, 2005; Person, 2013)	10
2.2	Definitions of Dashboard	11
2.3	Characteristics of a Dashboard (Malik, 2005)	13
2.4	Dashboard Design Guideline (Malik, 2005)	19
2.5	Dashboard Design Guideline (Jespersen, 2017)	20
2.6	Dashboard Design Guideline Studies	21
2.7	Dashboard Design Guideline Summary	25
2.8	Comparisons of Dashboard's Type	31
2.9	Dashboard's Purposes and Features (Rahman, Adamu, & Harun, 2017)	33
2.10	Summary of common color use with their Relative Meaning (Iliinsky & Steele, 2011)	38
4.1	Study on RADIS	62
4.2	UTM APRPD's Information Content Summary	64
4.3	Dashboard Selection Model for UTM APRPD	68
4.4	Operational Dashboards Features	69
4.5	Visualization Type for Selected Information	70
4.6	UTM APRPD's Information Design	81
5.1	Relation between the Interview Questions with the Dashboard Design Guideline Used	91

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	RADIS Homepage	3
1.2	Example of RADIS interface	4
1.3	KAI's interface	5
2.1	Dashboard Development Process (Staron, 2015)	15
2.2	Dashboard Development Process (Rasmussen, Bansal, & Chen, 2009)	15
2.3	The stages focused for the study	16
2.4	Dashboard Presentation (Malik, 2005)	17
2.5	Mapping Users to the Dashboard (Eckerson, 2011)	27
2.6	Examples of dashboard's Layout (Presthus & Canales, 2015)	37
2.7	Color Type to Display Data (Gemignani, 2009)	38
2.8	Examples of Bar Chart (Eckerson, 2011)	39
2.9	Examples of Line Chart (Few, 2006)	40
2.10	Examples of Pie Chart (Few, 2006)	41
2.11	Example of Table (Gemignani, 2009)	42
2.12	Juice's Simple Font Framework (Gemignani, 2009)	43
2.13	Removing unnecessary design (Gemignani, 2009)	44
2.14	PIM activities (Jones, 2005, 2012)	46
3.1	Phases in Research Methodology	51
4.1	Research Grant's Homepage	58
4.2	The H-Index Display	60
4.3	KAI's Report Card page	61
4.4	UTM APRPD Activities Conceptual Model (Adapted from Jones, 2012)	66

4.5	UTM APRPD's Information Layout Design	72
4.6	UTM APRPD's Main Page	73
4.7	Example of the Bar Sizes	74
4.8	Publication Achievement Details	75
4.9	Research Grant Fund Achievement Details	76
4.10	Publication Impact Factor	76
4.11	Active Research Grant Expanses Progress	77
4.12	Overall Publication Performance	78
4.13	Overall Research Grant Performance	79
4.14	Impact Factor Data Context	80
5.1	Interview Results Analysis (Section B): Question 2- 4	87
5.2	Interview Results Analysis (Section C): Question 1	88

LIST OF ABBREVIATIONS

3D	-	Three Dimension
APRPD	-	Academician Personal Research and Publication Dashboard
BI	-	Business Intelligence
GP	-	Graphical Presentation
IT	-	Information Technology
KAI	-	Key Amal Indicator
KPI	-	Key Performance Indicator
LR	-	Literature Review
MyRA	-	Malaysia Research Assessment Instrument
PIM	-	Personal Information Management
RADIS	-	Research and Development Information System
RMC	-	Research Management Centre
UTM	-	Universiti Teknologi Malaysia

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	UTM Strategy Map	104
B	Study of Dashboard Application from Managerial Perspective	105
C	Briefing with the RMC's IT Unit	112
D	Interview Questions	115
E	Interview Result	119

CHAPTER 1

INTRODUCTION

1.1 Overview

Data visualization plays an important role in delivering effective information to the user in a system. The existing mode of data delivery like standardized report distribution or drag-and-drop reporting does not seem enough nowadays (Malik, 2005). The traditional ways of presenting the data are often not rational anymore as they often seem too static. For instance, most of the report analysis is presented in a table, it may work for a number of data, but when it comes with a large set of data it may cause data overload.

The availability of Business Intelligence (BI) tools nowadays has given a solution for this problem. One of the BI tools is a dashboard (Presthus & Bergum, 2015). The dashboard is widely used in different industries for different purposes. According to Wajong (2015), the dashboard is displaying important information in the form of visual indicators, tables, reports, and alert mechanism which happens in performance management. However, the visual content of the dashboard is depending on its user's level of management or their position in the organization. The organization needs to employ different types of dashboard for the staff accordingly to their managerial level in order to enhance their decision making

As one of Malaysian Research University, Universiti Teknologi Malaysia (UTM) is emphasizing on producing high impact research publication (Hair Zaki, 2016). UTM is encouraging the academician, which consist of the postgraduates and lecturers to publish research papers by following the Key Performance Indicator (KPI) set by the university's top management. UTM is also giving out funding from their collaborators to the academician to boost their research works. UTM Research Management Centre (RMC) plays an important role in this mission. They are responsible for managing the research activities within the UTM. All the academician in UTM are using Research and Development Information System (RADIS) to keep their research information like research grant, research publication, their Key Amal Indicator (KAI) and their awards list. By using RADIS, their research information is available to be accessed when necessary. This study will use the RADIS as the case study to apply the dashboard design, which will improve the RADIS's data visualizations.

1.2 Research Background

RADIS stand for Research and Development Information System that used by UTM academician to keep their research and development's work information. This system is handled by UTM Research Management Centre (RMC). One of the RMC responsibility is to manage and facilitate research and development activities around UTM. They collaborate with many organizations internally and externally such as Ministry of Higher Education (MOHE), Ministry of Science, Technology and Innovation (MOSTI), Small and Medium Industry Development Corporation (SMIDEC), a research institute and other universities. Through this collaboration, RMC is putting all their effort on acquiring funding from the potential sponsor (Research Management Centre UTM, 2016)

The academician will apply for the research grant from the RMC to fund their new project. All the information about the research and development activities are stored in the RADIS. The information stored in RADIS is academicians' list of grants applied, the total number of publications that they have made, their award and recognition and also their Key Amal Indicator (KAI) to be achieved. This system helps the academician to keep track of their research activities and they can easily access the system by using their own user id and password

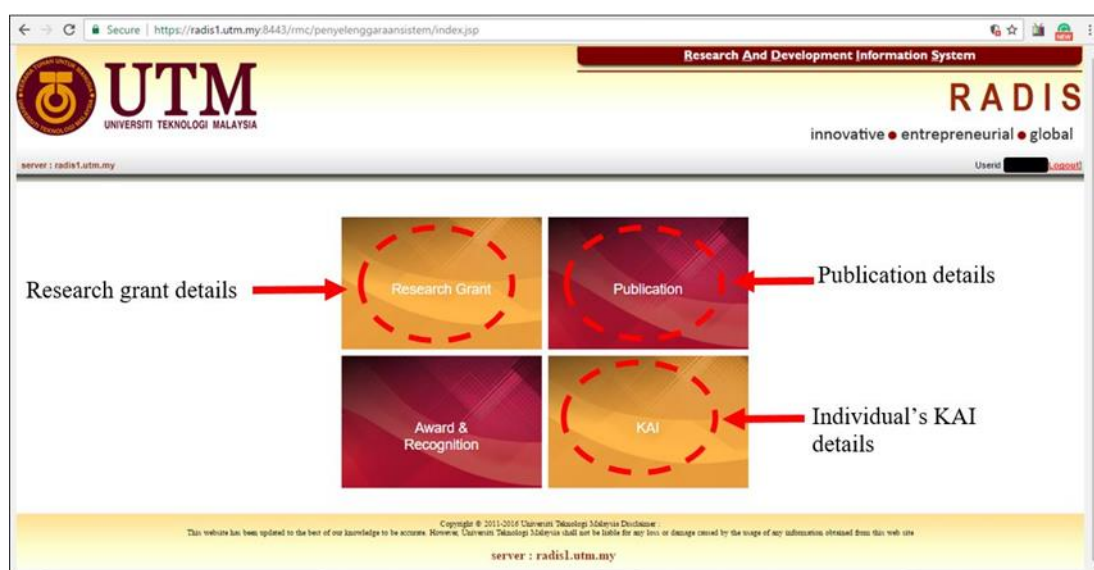


Figure 1.1 RADIS Homepage

RADIS is following the KPI that is set accordingly to the Malaysia Research Assessment Instrument II (MyRA II). This instrument is to evaluate matured research university, which focusing on producing excellence and high quality of research (UTM, 2012). According to Hair Zaki (2016), instead of using Key Performance Indicator (KPI) terminology, UTM is using the Key Amal Indicator (KAI) term as their performance measuring scheme. KAI act as the UTM's strategic plans monitoring tool (Key Amal Indicator, 2015). The UTM strategy map can be seen in Appendix A. In RADIS, the KAI is set as a different module apart from the publication and research grant module. The user needs to perform different task in order to check for the details of their research grant, research publication and their KAI achievement (As shown in Figure 1.1).

All the data presented in the RADIS is in the form of tables, which some time showing the unnecessary data that the user wants to see. The data presented is sufficient enough for the user to view, but it does not deliver the information effectively. This derived the problem of “rich in data, poor in information” (Malik, 2005; Presthus & Canales, 2015). Data visualization concepts play an important role to solve this problem, how the data is presented can help the user to understand the information more clearly.

LIST OF APPROVED PROJECTS

Role : Principal Investigator

No	Ref No	Cost Center No	Proposal Status	Project Status	Project Title	Grant
1	PV/2016/0655	Q.J130000.2328.14H95	APPROVED	ACTIVE	GUIDELINES FOR DESIGNING BI DASHBOARD BASED ON MANAGEMENT LEVEL	Tier 1
2	PV/2016/02426	Q.J130000.2528.08H13	APPROVED	COMPLETED	Managing Continual Quality Improvement for Academic Quality Assurance Through Metamodelling Approach	Tier 1
3	PV/2016/06556	Q.J130000.2428.01G09	APPROVED	COMPLETED	DIGITAL PRESERVATION OF KNOWLEDGE ON HANDICRAFT CREATION	Flagship
4	PV/2016/06450	R.J130000.7828.4F125	APPROVED	COMPLETED	Resource-Based Framework of Green IT Capability towards sustainable IT services	PRGS
5	PV/2016/06354	R.J130000.7728.43022	APPROVED	COMPLETED	Computer-Assisted Assessment (CAA) for Problem-Based Learning	UTMP

10 records found

Role : Collaborator / Member

No	Ref No	Cost Center No	Proposal Status	Project Status	Project Leader Name	Staff No	Research Alliance	Project Title	Grant
1	PV/2016/07993	R.J130000.7828.4L402	APPROVED	ACTIVE	SURAYA BINTI MISKON	8178	SMART DIGITAL COMMUNITY	Customer Relationship Management (CRM) System for Greentree Workshop	CWGS
2	PV/2016/07932	R.J130000.7813.4L678	APPROVED	ACTIVE	NOORMINSHAH BINTI A. IAHAD	8500	SMART DIGITAL COMMUNITY	Fast & Furious: A Holistic Computer Assisted Problem Based Learning Assessment Tool	PRGS
3	PV/2016/07484	Q.J130000.2628.12327	APPROVED	ACTIVE	NAZMONA BINTI MAT ALI	6392	SMART DIGITAL COMMUNITY	IT Shared Service Implementation Framework for E-Government Tier 2	Tier 2
4	PV/2016/07027	R.J130000.7728.43241	APPROVED	ACTIVE	AHMAD FADHL BIN YUSOF	13837	SMART DIGITAL COMMUNITY	Framework for Embedding gamification in Massive Open Online Course	Dpp
5	PV/2016/06324	Q.J130000.2528.14H07	APPROVED	ACTIVE	NAOMIE BT SALIM	5540	SMART DIGITAL COMMUNITY	PROFILING OF FOREIGN WORKERS IN PENGERANG	IISJ

23 records found

LIST OF NETWORKING GRANT

Figure 1.2 Example of RADIS interface

Figure 1.2 shows the example of RADIS interface. Both publications and research grant module are using the same type presentation display. A table is used to view all the information and categorized into specific group of data. In addition, other difficulties for the user is their publication list is too long and there is no mechanism that notifies their achievements within the two modules. They need to refer to the KAI module to see their performance analysis. Figure 1.3 shows the interface for the KAI module. This study proposes the usage of dashboard to display the academicians' personal research and publication information. Although the use of dashboard can improve the interface design of a system, there is no specific design for the developer to follow.

The screenshot displays the KAI interface with the following data:

Category	Salary Grade	Total Target Amount (RM)	Total Approved Amount (RM)
a. Funding from government agencies (CUP/Institution)	DS54	32,000.00	[Redacted]
b. Funding from private agencies including contract research (Others)	DS54	30,000.00	[Redacted]
c. International funding	DS54	40,000.00	[Redacted]

Figure 1.3 KAI's interface

The data can be presented in a form of two-dimensional reports, scorecards, dashboard and data mining (sophisticated searches and queries) (Presthus & Canales., 2015; Watson, 2016; Yigitbasioglu & Velcu, 2012). In this study, the dashboard is selected to improve RADIS data visualization and will only focus on Research Grant module and Publications module. The purpose of this study is to identify the design guideline for UTM academician personal research and publication dashboard.

1.3 Problem Statement

As mentioned earlier, how the data presented in a system are very important for the user, as they will have to make a decision or for them to analyze the information presented. Since the RADIS is mainly using tables to display information, the use of dashboard can enhance RADIS interface design, other than that, the dashboard can reduce the unnecessary data from the user view. The dashboard application can help the academician to be more alert with their performance and work to achieve their KAI. However, in order to deploy this application in an organization, there are several things to be clarified first. In the previous study, Yigitbasioglu and Velcu (2012) had addressed that there is no specific guideline to design the dashboard. They also mentioned that if the developers overdo the design, it can distract the attention of the

user and caused decision distraction. Thus, this study will try to address the gap by researching the design guideline for the UTM academician personal research and publication dashboard.

1.4 Research Questions

Based on the discussion made in research background section, a list of research questions for this study is identified as follows:

1. What is the dashboard design guideline for UTM APRPD?
2. What are the visualization features to be included in the UTM APRPD?
3. Does the dashboard design guideline identified meet the UTM academician's requirement?

1.5 Research Objectives

From the research question formulated for this study, the research objectives of this study are listed as follows:

1. To identify the dashboard design guideline for UTM APRPD.
2. To identify the visualization features to be included in the UTM APRPD.
3. To validate the dashboard design guideline identified for UTM APRPD.

1.6 Scope of the Study

This research is focusing on identifying the design guideline for the proposed dashboard. The dashboard will be displaying user's individual Research Grant module and Publications module of RADIS. UTM APRPD will improve the visual representation of the system, which will enhance the information display for the user. The respondents for this study is the UTM academician, in this context they are the lecturers in UTM who are using the system. Their level of management in UTM is as the operational manager. The purpose of the dashboard of this study is to monitor and analyze the academician individual performance in publishing and their research grant performance.

1.7 Significant of the Study

The outcome of this study will help to design the UTM APRPD, which will be used to view the academician personal Research Grant module and Publications module. This improvement is to ease the academician to view the necessary information before going into the details of their Research Grant information and Publications information. UTM APRPD can be used to monitor individual performance in publication and analyze their research grant progress. The use of UTM APRPD can motivate the user to perform well to achieve their KAI in research and development activities.

1.8 Thesis Structure

This study is divided into six chapters. The first chapter discussing on the overview of the problem arises, research questions and its objectives, research scope and significance of the study. Secondly, Chapter 2 provides the literature studies

performed to identify the research gap of the study. The second chapter will cover all the related concepts such as the dashboard overview, data visualization study, and personal information management. Next, Chapter 3 elaborates the step taken in order to execute all the objectives of the study. Chapter 4 is where the UTM APRPD prototype is designed following the design guideline identified from the second chapter. Chapter 5 explained the validation step taken for the study. An interview session was conducted with the users to measure their willingness to use the dashboard. Finally, Chapter 6 provides the overall achievements of the study, research contribution, research limitation, and the conclusion of the study.

REFERENCES

- Apandi, S. H., & Arshah, R. A. (2016). The Need of Dashboard in Social Research Network Sites for Researchers. *International Journal of Software Engineering and Computer Systems*, 2(1), 120-132.
- Barth, K. B., & Formoso, C. T. (2008). *Improvement of performance measurement systems using production management dashboards*. Paper presented at the 16th Annual Conference of the International Group for Lean Construction, Manchester, UK.
- Bergman, O., Boardman, R., Gwizdka, J., & Jones, W. (2004). *Personal information management*. Paper presented at the Chi'04 extended abstracts on human factors in computing systems, Boston.
- Chaudhuri, S., Dayal, U., & Narasayya, V. (2011). An overview of business intelligence technology. *Communications of the ACM*, 54(8), 88-98.
- Corrin, L., & de Barba, P. (2015). *How do students interpret feedback delivered via dashboards?* Paper presented at the Proceedings of the Fifth International Conference on Learning Analytics And Knowledge, Poughkeepsie, NY, USA.
- Corrin, L., Kennedy, G., de Barba, P., Bakharia, A., Lockyer, L., Gasevic, D., . . . Copeland, S. (2015). *Loop: A learning analytics tool to provide teachers with useful data visualisations*. Paper presented at the 32nd Conference of Australian Society for Computers in Learning in Tertiary Education, Perth.
- Day, N. (2007). *Achieving User Satisfaction in Content Management Systems*. (Master's Thesis), Lancaster University, United Kingdom.
- De Croon, R., Klerkx, J., & Duval, E. (2015). *Design and evaluation of an interactive proof-of-concept dashboard for general practitioners*. Paper presented at the Healthcare Informatics (ICHI), 2015 International Conference Texas, USA.

- Dhillon, S. K., Ibrahim, R., & Selamat, A. (2013). Strategy identification for sustainable key performance indicators delivery process for scholarly publication and citation. *Int. J. Inf. Technol. Manag*, 3(3), 103-113.
- Dragomirescu, S. E., & Solomon, D. C. (2013). The Role Of The Performance Dashboard In The Management Of Modern Enterprises. *Studies and Scientific Researches. Economics Edition*(18), 166-176.
- Eckerson, W. W. (2011). *Performance dashboards: measuring, monitoring, and managing your business* Retrieved 03.05.2017 from <https://www.safaribooksonline.com/>
- Elias, M. (2012). *Enhancing User Interaction with Business Intelligence Dashboards*. (PHD's Thesis), Ecole Centrale Paris, France.
- Few, S. (2006). *Information Dashboard Design: The Effective Visual Communication of Data*. North Sebastopol, California: O'Reilly Media, Incorporated.
- Forsgren, M. (2015). *Designing a Risk Manager Dashboard*. (Master's Thesis), Umea University, Sweden.
- Ganapati, S. (2011). *Use of dashboards in government*. Washington DC: IBM Center for the Business of Government.
- Gaur, P., & Arora, M. (2016). CRM Dashboard for Square Yards: An Application of Business Analytics. *Business and Management Research Journal*, 6(2), 1-11.
- Gemignani, Z. (2009). A Guide to Creating Dashboards People Love to Use. Retrieved 09.08.2017 from <http://www.dashboardinsight.com/articles/digitaldashboards/fundamentals/a-guide-to-creating-dashboards-people-loveto-use-part-3.aspx>
- Gröger, C., Hillmann, M., Hahn, F., Mitschang, B., & Westkämper, E. (2013). The operational process dashboard for manufacturing. *Procedia CIRP*, 7, 205-210.
- Hansoti, B. (2010). *Business Intelligence Dashboard in Decision Making*. (Master's Thesis), Purdue Univeristy, USA.
- Iiinsky, N., & Steele, J. (2011). *Designing data visualizations: representing informational relationships*. North Sebastopol, California: O'Reilly Media, Inc.

- Jespersen, S. (2017). *Dashboard Design Guidelines for Improved Evidence Based Decision Making in Public Health in Developing Countries*. (Master's Thesis), University of Oslo, Norway.
- Jones, W. (2005). Personal information management. *Annual review of information science and technology*, 41(1), 453-504.
- Jones, W. (2012). *The future of personal information management, part I: our information, always and forever* Vol. 4. G. Marchionini (Ed.) *Synthesis lectures on information concepts, retrieval, and services* (pp. 1-125). Retrieved 11.06.2017 from <https://www.safaribooksonline.com/>
- Kim, H., Lee, Y.-H., Yim, H., & Cho, N. W. (2007). *Design and implementation of a personalized business activity monitoring system*. Paper presented at the International Conference on Human-Computer Interaction, Berlin Heidelberg.
- Kim, J., Jo, I.-H., & Park, Y. (2016). Effects of learning analytics dashboard: analyzing the relations among dashboard utilization, satisfaction, and learning achievement. *Asia Pacific Education Review*, 17(1), 13-24.
- Maldonado, R. M., Kay, J., Yacef, K., & Schwendimann, B. (2012). *An interactive teacher's dashboard for monitoring groups in a multi-tabletop learning environment*. Paper presented at the International Conference on Intelligent Tutoring Systems, Berlin, Heidelberg.
- Malik, S. (2005). *Enterprise dashboards: design and best practices for IT*. Canada: John Wiley & Sons.
- Masron, T. A., Ahmad, Z., & Rahim, N. B. (2012). Key performance indicators vs key intangible performance among academic staff: A case study of a public university in Malaysia. *Procedia-Social and Behavioral Sciences*, 56, 494-503.
- Mellegård, N., Staron, M., & Törner, F. (2012). *A light-weight defect classification scheme for embedded automotive software and its initial evaluation*. Paper presented at the Software Reliability Engineering (ISSRE), 2012 IEEE 23rd International Symposium on.
- Miller, G. A. (1994). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological review*, 101(2), 343.

- Mohd, E. M. Y. (2015). *Enhanced Dashboard for Operational Decision Support in Manufacturing Based Company*. (Master's Thesis), Universiti Teknologi Malaysia, Skudai, Johor.
- MyRAII. (2016). Glossary MyRA II. Retrieved 19.04.2017 from <http://app2.mohe.gov.my/ru/>
- Pauwels, K., Ambler, T., Clark, B. H., LaPointe, P., Reibstein, D., Skiera, B., . . . Wiesel, T. (2009). Dashboards as a service: why, what, how, and what research is needed? *Journal of Service Research*, 12(2), 175-189.
- Person, R. (2013). *Balanced scorecards and operational dashboards with Microsoft Excel*. Retrieved 23.10.2017 from <https://www.safaribooksonline.com/>
- Presthuis, W., & Bergum, I. (2015). *Business Intelligence to the People. A Case Study of Dashboard Adoption in the Health Care sector*. Paper presented at the Nor. Konf. Organ. bruk av IT.
- Presthuis, W., & Canales, C. (2015). *Business Intelligence Dashboard Design. A Case Study of a Large Logistics Company*. Paper presented at the Norsk konferanse for organisasjoners bruk av IT.
- Rahman, A. A., Adamu, Y. B., & Harun, P. (2017). *Review on dashboard application from managerial perspective*. Paper presented at the Research and Innovation in Information Systems (ICRIIS), 2017 International Conference on, Langkawi.
- Rasmussen, N. H., Bansal, M., & Chen, C. Y. (2009). *Business dashboards: a visual catalog for design and deployment*. Hoboken, New Jersey: John Wiley & Sons.
- Rivera, S. D., & Shanks, G. (2015). A dashboard to support management of business analytics capabilities. *Journal of Decision Systems*, 24(1), 73-86.
- Saputra, D., Soleh, O., & Dewi, M. A. (2013). DASHBOARD MARKETING SYSTEM FOR STUDENT'S ENROLLMENT CASE STUDY: UNIS TANGERANG. *Information Systems International Conference (ISICO)*, 294-299.
- Schwendimann, B. A., Rodríguez-Triana, M. J., Vozniuk, A., Prieto, L. P., Boroujeni, M. S., Holzer, A., . . . Dillenbourg, P. (2016). *Understanding learning at a glance: An overview of learning dashboard studies*. Paper presented at the Proceedings of the Sixth International Conference on Learning Analytics & Knowledge.

- Shahin, A., & Mahbod, M. A. (2007). Prioritization of key performance indicators: An integration of analytical hierarchy process and goal setting. *International Journal of Productivity and Performance Management*, 56(3), 226-240.
- Stadler, J. G., Donlon, K., Siewert, J. D., Franken, T., & Lewis, N. E. (2016). Improving the efficiency and ease of healthcare analysis through use of data visualization dashboards. *Big data*, 4(2), 129-135.
- Staron, M. (2015). Dashboard development guide How to build sustainable and useful dashboards to support software development and maintenance. Göteborg, Sweden: Chalmers University of Technology & University of Gothenburg.
- Staron, M., Niesel, K., & Meding, W. (2015). Selecting the Right Visualization of Indicators and Measures–Dashboard Selection Model *Software Measurement* (pp. 130-143): Springer.
- Velcu-Laitinen, O., & Yigitbasioglu, O. M. (2012). The Use of Dashboards in Performance Management: Evidence from Sales Managers. *International Journal of Digital Accounting Research*, 12, 39-58.
- Verbert, K., Duval, E., Klerkx, J., Govaerts, S., & Santos, J. L. (2013). Learning analytics dashboard applications. *American Behavioral Scientist*, 57(10), 1500-1509.
- Vivian, R., Tarmazdi, H., Falkner, K., Falkner, N., & Szabo, C. (2015). *The development of a dashboard tool for visualising online teamwork discussions*. Paper presented at the Software Engineering (ICSE), 2015 IEEE/ACM 37th IEEE International Conference on.
- Wajong, A. M. (2015). Applying Performance Dashboard in Hospitals. *International Journal Of Software Engineering and Its Applications*, 9(1), 213-220.
- Yigitbasioglu, O. M., & Velcu, O. (2012). A review of dashboards in performance management: Implications for design and research. *International Journal of Accounting Information Systems*, 13(1), 41-59.
- Zaki, U. H. H. (2016). *Web Service Architecture for Scholarly Publication*. (Master's Thesis), Universiti Teknologi Malaysia, Skudai Johor.
- Ziuziański, P., Furmankiewicz, M., & Sołtysik-Piorunkiewicz, A. (2014). E-health artificial intelligence system implementation: case study of knowledge management dashboard of epidemiological data in Poland. *International Journal of Biology and Biomedical Engineering*, 8, 164-171. .