

**XBRL: INTERACTIVE DATA VISUALISATION AND  
DECISION-MAKING PROCESS IN INTERNET FINANCIAL  
REPORTING**

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KUALA LUMPUR**

**2022**

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JUDUL: XBRL: INTERACTIVE DATA VISUALISATION AND  
DECISION MAKING PROCESS IN INTERNET FINANCIAL  
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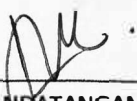
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## ABSTRACT

Interactive data visualisation (IDV) in the context of internet financial reporting (IFR) has emerged and become more prevalent following the development and implementation of eXtensible Business Reporting Language (XBRL). IDV, which stands for a high-level Website interactivity and features navigation or hyperlinks for IFR representation, may help users process massive amounts of complex information efficiently. Thus, reducing the cognitive load on the users when making financial analyses and judgements. However, the effect of IDV on users' cognition in the context of IFR remained inconclusive because existing research tended to concentrate on the impact of IDV on users' decision-making outcomes rather than the processes involved. It is worth to note that decision-making involves two distinct parts: processes and outcomes. The former can be related to decision accuracy and optimisation. Whereas the latter offers insight into how users interact with information representations like IDV, which can be investigated through user satisfaction and information usability. It is essential to examine users' decision-making processes, as different types of decisions require different information cues that affect their cognition and judgements. Additionally, users' characteristics like their knowledge and experience, and the tasks (simple or complex financial analyses and judgements) influenced the information representation choices they make. Therefore, this study was motivated to investigate the impact of IDV on users' cognitive loads during decision-making processes in the context of IFR. Cognitive Load Theory and Cognitive Fit Theory guided the study's hypotheses, and a 2x2 full factorial experimental design was utilised. The IDV was manipulated into two conditions: high-level interactive websites and low-level interactive websites. Similarly, the financial analyses and judgments, which is known as task characteristics were also manipulated into two conditions: simple or complex tasks. A total of 140 participants participated in this experimental research. The results revealed that users who interacted with the high-level

interactive websites reported greater satisfaction than users who interacted with the low-level interactive website. Nonetheless, no significant difference was found in the effect of IDV on information usability between users in high-level and low-level interactive webs. Interestingly, it was found that task complexity influenced the relationship between IDV and users' satisfaction. The more complex the task, the higher the user's cognitive load, thus adversely affecting the user's satisfaction. Hence, a greater level of user satisfaction was found only when the users completed simple tasks. Furthermore, the task complexity influenced the relationship between IDV and information usability, where the more complex the task, the higher the user's cognitive load, thus reducing information usability. Excitingly, the study also uncovered that a users' characteristics play a significant role in moderating the effects of task complexity in the relationship between IDV, user satisfaction, and information usability. It revealed that user experience is more profound than user knowledge. User experience significantly affects how complex a task might be perceived in relation to IDV and user satisfaction, as well as affecting IDV and information usability. The effects are stronger when users complete simple tasks in a low-level interactive condition. The implications and directions for future research are also discussed.

**Keywords:** XBRL, Internet Financial Reporting, Interactive Data Visualisation, Cognitive Load Theory, Cognitive Fit Theory

## ABSTRAK

Visualisasi data interaktif (IDV) dalam konteks pelaporan kewangan internet (IFR) telah muncul dan menjadi lebih berleluasa berikutan pembangunan dan pelaksanaan Bahasa Pelaporan Perniagaan eXtensible (XBRL). IDV, yang merupakan interaktiviti web peringkat tinggi dengan ciri navigasi atau hiperpautan untuk pameran IFR, boleh membantu pengguna memproses sejumlah besar maklumat kompleks dengan cekap. Oleh itu, mengurangkan beban kognitif pada pengguna apabila membuat analisa dan keputusan kewangan. Walau bagaimanapun, kesan IDV ke atas kognisi pengguna dalam konteks IFR kekal tidak konklusif kerana penyelidikan sedia ada cenderung untuk menumpukan pada kesan IDV ke atas hasil membuat keputusan pengguna dan bukannya proses yang terlibat. Perlu diingat bahawa pembuatan keputusan melibatkan dua bahagian yang berbeza: proses dan hasil. Yang pertama boleh dikaitkan dengan ketepatan dan pengoptimuman keputusan, manakala yang kedua menawarkan cerapan tentang cara pengguna berinteraksi dengan pameran maklumat seperti IDV, yang boleh disiasat melalui kepuasan pengguna dan kebolehgunaan maklumat. Adalah penting untuk menyiasat proses membuat keputusan pengguna, kerana jenis keputusan yang berbeza memerlukan capaian maklumat yang berbeza yang mempengaruhi kognitif pengguna. Selain itu, ciri pengguna, seperti pengetahuan dan pengalaman mereka, serta jenis tugas (mudah atau kompleks) mempengaruhi pilihan pameran maklumat yang mereka buat. Oleh itu, kajian ini bermotivasi untuk menyiasat kesan IDV ke atas beban kognitif pengguna semasa proses membuat keputusan dalam konteks IFR. Teori Beban Kognitif dan Teori Fit Kognitif membimbing hipotesis kajian, dan reka bentuk eksperimen faktorial penuh 2x2 telah digunakan. Dua syarat telah digunakan untuk memanipulasi IDV: web interaktif peringkat tinggi dan web interaktif peringkat rendah. Sebaliknya, analisa kewangan dan pertimbangan pengguna yang dikenali sebagai ciri tugas juga dimanipulasi kepada dua keadaan: tugas mudah atau kompleks. Seramai 140 peserta telah

mengambil bahagian dalam penyelidikan eksperimen ini. Hasilnya menunjukkan bahawa pengguna yang berinteraksi dengan web interaktif peringkat tinggi melaporkan kepuasan yang lebih tinggi daripada pengguna yang berinteraksi dengan web interaktif peringkat rendah. Malah, keputusan menunjukkan tiada perbezaan yang signifikan dalam kesan IDV terhadap kebolegunaan maklumat antara pengguna dalam web interaktif peringkat tinggi dan rendah. Selain itu, didapati bahawa kerumitan tugas mempengaruhi hubungan antara IDV dan kepuasan pengguna. Lebih kompleks tugas, lebih tinggi beban kognitif pengguna, sekali gus menjejaskan kepuasan pengguna. Oleh itu, tahap kepuasan pengguna yang lebih tinggi didapati hanya apabila pengguna menyelesaikan tugas mudah. Tambahan pula, kerumitan tugas mempengaruhi hubungan antara IDV dan kebolegunaan maklumat, di mana semakin kompleks tugas, semakin tinggi beban kognitif pengguna, sekali gus mengurangkan kebolegunaan maklumat. Menariknya, kajian itu juga mendedahkan bahawa ciri pengguna memainkan peranan penting dalam menyederhanakan kesan kerumitan tugas dalam hubungan antara IDV, kepuasan pengguna dan kebolegunaan maklumat. Ia mendedahkan bahawa pengalaman pengguna lebih memberikan kesan daripada pengetahuan pengguna. Pengalaman pengguna memberi kesan dengan ketara betapa kompleksnya tugas mungkin dilihat berkaitan dengan IDV dan kepuasan pengguna, serta menjejaskan IDV dan kebolegunaan maklumat. Kesannya lebih kuat apabila pengguna menyelesaikan tugas mudah dalam keadaan interaktif tahap rendah. Implikasi dan hala tuju untuk penyelidikan masa depan juga dibincangkan.

Keywords: XBRL, Pelaporan Kewangan Internet, Visualisasi Data Interaktif, Teori Beban Kognitif, Teori Kognitif Fit.

## ACKNOWLEDGEMENTS

Firstly, Alhamdulillah and greatest thank you to Allah SWT for the blessing, strength, patience, and guidance throughout this PhD journey. This was not an easy feat, but it would have been impossible without consistent prayers, commitment, passion, and hard work.

I am eternally grateful to both of my supervisors, Associate Professor Dr. Anna Azriati Che Azmi and Professor Dr. Noor Ismawati Jaafar for their encouragement, devotion, knowledge, and guidance throughout my entire PhD journey. I would not have been able to accomplish this dissertation without their assistance. Additionally, I would like to express my heartfelt appreciation to the members of the committee and staffs of the Graduate School of Business, Faculty of Business and Economics, Universiti Malaya, for their kind assistance and support throughout my PhD. I would want to express my gratitude to my fellow PhD students for their unwavering encouragement and companionship throughout this journey.

Above all, I owe a debt of gratitude to my family, siblings, and in-laws for their unwavering loves, prayers, and support. My extended family has been a constant source of encouragement over these years. My children, Andi Airel and Andi Elyas, have been a continual source of joy and a motivating force, encouraging me to pursue this aim even during difficult moments. My husband, Wahyudi Andi Anas, has been a tremendous emotional and physical support. I will forever be indebted to him for his encouragement and devotion in assisting me to achieve my dream. I honestly do not know what I would do without him encouraging me to continue my work while shouldering my obligations so I could concentrate on finishing my dissertation. Last, but not least, I dedicate this PhD thesis to my late mother, Abbasia Isman, and my late brother, Jamir Unai, who were always there to shower me with their unconditional love and support until their last breath.



# TABLE OF CONTENTS

Abstract.....	iii
Abstrak.....	v
Acknowledgements.....	7
Table of Contents.....	8
List of Figures.....	14
List of Tables.....	16
List of Abbreviations.....	18
List of Appendices.....	19
<b>CHAPTER 1: INTRODUCTION .....</b>	<b>20</b>
1.1 Background of Study.....	20
1.2 Scope of Study .....	24
1.3 Identification of Research Problem.....	27
1.4 Research Question.....	31
1.5 Research Objectives .....	32
1.6 Research Implication.....	32
1.6.1 Theoretical Implication.....	32
1.6.2 Policy Implication and Practical Implication.....	33
1.7 Organisation of the Thesis.....	34
<b>CHAPTER 2: LITERATURE REVIEW .....</b>	<b>36</b>
2.1 Introduction .....	36
2.2 Internet Financial Reporting and eXtensible Business Reporting Language.....	36
2.3 Interactive Data Visualisation (IDV) .....	40
2.3.1 Data Visualisation.....	42

2.3.2	Data Visualisation Research in The Accounting Field.....	44
2.3.3	Web Interactivity.....	45
2.3.4	Web Interactivity Research in The Accounting Field.....	47
2.3.5	Web Interactivity Research in other Fields.....	54
2.4	IDV and Decision Making .....	56
2.4.1	IDV and Users' Satisfaction .....	57
2.4.2	IDV and Information Usability .....	61
2.5	IDV and Users' Characteristics.....	69
2.5.1	Users' Domain Knowledge .....	70
2.5.2	Users' Domain Experience .....	73
2.6	IDV and Task Characteristics.....	78
2.7	Review of Theories .....	84
2.7.1	Bounded Rationality .....	84
2.7.2	Dual-Coding Theory .....	85
2.7.3	Cognitive Load Theory .....	85
2.7.4	Cognitive Fit Theory.....	88
2.8	Chapter Summary.....	92

### **CHAPTER 3: RESEARCH MODEL AND HYPOTHESES DEVELOPMENT ... 93**

3.1	Introduction .....	93
3.2	Theoretical Foundation .....	93
3.3	Development of Hypotheses .....	97
3.3.1	The Relationship Between IDV, Cognitive Load, and User Satisfaction	97
3.3.2	The Effect of Task Characteristics on the Relationship Between IDV, Cognitive Load, and User Satisfaction. ....	98
3.3.3	The effect of Users' Characteristics on The Relationship between Task Characteristics, IDV, Cognitive Load, and User Satisfaction.....	100

3.3.4 The Relationship Between IDV, Cognitive Load and Information Usability

104

3.3.5 The Effect of Task Characteristics on the Relationship Between IDV, Cognitive Load, and Information Usability ..... 106

3.3.6 The Effect of Users' Characteristics on The Relationship Between IDV, Problem-Solving Task Characteristics and Information Usability. .... 108

3.4 Summary of Research Hypotheses..... 111

3.5 Chapter Summary..... 113

**CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY ..... 114**

4.1 Introduction..... 114

4.2 Research Philosophy ..... 114

4.3 Research Methodologies and Strategies..... 115

4.3.1 The Experimental Design..... 116

4.4 Measurements..... 117

4.4.1 Independent Variables..... 117

4.4.2 Dependent Variable Measurement..... 119

4.4.3 Mediating Variable Measurement..... 119

4.4.4 Experimental Procedure ..... 120

4.4.5 Development of Experimental Materials ..... 122

4.4.6 Pre- Testing Procedure ..... 124

4.4.7 Pilot study ..... 124

4.5 Population and Sample Size Determination..... 125

4.5.1 Population and Unit of Analysis ..... 125

4.5.2 Sample Size Determination..... 125

4.5.3 Participants Recruitment and Data Collection ..... 127

4.6 Data Analysis ..... 129



4.7	Summary of Operationalisation of Variables.....	130
4.8	Chapter Summary.....	131
<b>CHAPTER 5: DATA ANALYSIS AND FINDINGS.....</b>		<b>132</b>
5.1	Introduction .....	132
5.2	Pilot Study Analysis.....	132
5.3	Data Collection.....	136
5.3.1	Demographic Profile Participants .....	137
5.4	Normality of Data.....	139
5.5	Data Analysis .....	140
5.6	Manipulation Checks.....	140
5.7	Reliability Test .....	142
5.8	Results and Findings of the Hypotheses .....	142
5.8.1	Results on the Relationship Between IDV, Cognitive Load, and User Satisfaction.....	143
5.8.2	Results on the Effects of Task Characteristics on the Relationship between IDV, Cognitive Load, and Users Satisfaction.....	144
5.8.3	Results on the Effects of User Characteristics on the Relationship between Task Characteristics, IDV, Cognitive Load, and User Satisfaction.....	148
5.8.4	Results on the Relationship Between IDV, Cognitive Load, and Information Usability .....	157
5.8.5	Results on the Effects of Task Characteristics on the Relationship Between IDV, Cognitive Load, and Information Usability .....	159
5.8.6	Results on the Effects of User Characteristics on the Relationship Between IDV, Task Characteristics, Cognitive Load, and Information Usability	162
5.9	Supplementary Analysis.....	174

5.9.1 Participants Recruitment and Data Collection Results on the Relationship Between IDV, Task Complexity, Cognitive Load, and User Satisfaction

174

5.9.2 Results on the Relationship between IDV, Task Complexity, Cognitive Load, and Information Usability ..... 182

5.10 Chapter Summary..... 186

**CHAPTER 6: DISCUSSION OF FINDINGS CONCLUSION..... 187**

6.1 Introduction ..... 187

6.2 Discussion of Findings ..... 187

6.2.1 The Effect of IDV on Cognitive Load and Decision-Making Processes: User Satisfaction and Information Usability in the Decision-Making Process ..... 187

6.2.2 The Effect of Task Characteristics on the Relationship between IDV, Cognitive Load, and Decision-Making Processes: User Satisfaction and Information Usability ..... 190

6.2.3 The Effect of User Characteristics on the Relationship between IDV, Task Characteristics, Cognitive Load, and Decision-Making Processes: User Satisfaction and Information Usability ..... 194

6.3 Chapter Summary..... 202

**CHAPTER 7: DISCUSSION OF FINDINGS CONCLUSION..... 203**

7.1 Introduction ..... 203

7.2 Summary ..... 203

7.3 Implications of the Study ..... 209

7.3.1 Theoretical Contributions ..... 209

7.3.2 Policy and Practical Implications..... 211

7.4 Research Limitation ..... 213

7.5 Future Research Direction..... 214

References..... 216

List of Publications and Papers Presented ..... 250

Appendix..... 251



**UMS**  
UNIVERSITI MALAYSIA SABAH

## LIST OF FIGURES

Figure 2.1: The Components of Cognitive Load .....	85
Figure 2.2: Cognitive Fit Theory .....	89
Figure 2.3: Modified Cognitive Fit Theory .....	90
Figure 2.4: Extended Cognitive Fit Theory .....	91
Figure 3.1: Theoretical Foundation - Cognitive Fit Theory (Shaft & Vessey, 2006).....	94
Figure 3.2: Adapted Theoretical Foundation Cognitive Fit Theory (Shaft & Vessey, 2006) .....	95
Figure 3.3: Moderated Mediation Relationship Between Task Complexity, IDV, Cognitive Load, User Satisfaction .....	100
Figure 3.4: Moderated Moderated Mediation Relationship Between Knowledge, Task Complexity, IDV, Cognitive Load, User Satisfaction .....	102
Figure 3.5: Moderated Moderated Mediation Relationship Between Experience, Task Complexity, IDV, Cognitive Load, User Satisfaction .....	104
Figure 3.6: Moderated Mediation Relationship Between Task Characteristics, IDV, Cognitive Load, Information Usability .....	107
Figure 3.7: Moderated Mediation Relationship Between Knowledge, Task Complexity, IDV, Cognitive Load, and Information Usability .....	109
Figure 3.8: Moderated Moderated Mediation Relationship Between Knowledge, Task Complexity, IDV, Cognitive Load, and Information Usability .....	111
Figure 4.1: Positivists Research Approach .....	115
Figure 4.2: Summary of Experiment Process and Procedures .....	122
Figure 4.3: Experimental Stages .....	125
Figure 4.4: G*Power Analysis for Sample Size Computation .....	127
Figure 5.1: The Mediation Effects of Cognitive Load between IDV and User Satisfaction .....	144
Figure 5.2: Moderated Mediation—Task Complexity as a Moderator between IDV, Cognitive Load, and Satisfaction .....	148

Figure 5.3: Three-way Interaction Effects Between IDV, User Experience, and Task Complexity on the Indirect Relationship Between Cognitive Load and User Satisfaction ..... 157

Figure 5.4: The Mediation Effects of Cognitive load between IDV and Information Usability..... 158

Figure 5.5: Moderated Mediation—Task Complexity as a Moderator Between IDV, Cognitive Load, and Information Usability ..... 162

Figure 5.6: Three-way Interaction Effects Between IDV, User Experience, and Task Complexity on the Indirect Relationship Between Cognitive Load Information Usability ..... 171

Figure 5.7: The Estimated Means of Satisfaction in Corresponding to Level of Task Difficulty and Level of Website Interactivity ..... 176

Figure 5.8: The Estimated Means of Satisfaction in Corresponding to Levels of Task Difficulty and Levels of Website Interactivity ..... 183



UMS  
UNIVERSITI MALAYSIA SABAH



## LIST OF TABLES

Table 2.1: The Definition of Usability.....	63
Table 2.2: Summary of Literature for Problem Solving Task Characteristics .....	80
Table 3.1: Summary of Research Hypotheses .....	111
Table 4.1: Configuration of the experiment.....	117
Table 4.2 Summary of Operationalisation of Variables. ....	130
Table 5.1: KMO and Barlett’s Test .....	133
Table 5.2: Results of the Factor Analysis (Principal Components Approach- Varimax Rotation) .....	134
Table 5.3: Items Included in the Factor Analysis Results .....	135
Table 5.4: Summary of Participants Category .....	137
Table 5.5: Summary of Groups and Participants.....	137
Table 5.6: Participants’ Demographic Profiles.....	139
Table 5.7: Descriptive Statistics and Independent Samples—T Results for Manipulated Variables .....	141
Table 5.8: Descriptive Statistics and Independent Samples—T Results for Manipulated Variables Following Participants Recruitment Channel.....	141
Table 5.9: Cronbach’s Alpha Result.....	142
Table 5.10: Results for Hypothesis 1 .....	143
Table 5.11: Results for Hypothesis 3 .....	147
Table 5.12: Results for Hypothesis 4.....	151
Table 5.13: Results for Hypothesis 5.....	155
Table 5.14: Result for Hypothesis 6 .....	157
Table 5.15: Results for Hypothesis 8.....	161
Table 5.16: Results for Hypothesis 9.....	166

## LIST OF ABBREVIATIONS

- XBRL : eXtensible Business Markup Language
- IFR : Internet Financial Reporting
- IDV : Interactive Data Visualisation
- CFT : Cognitive Fit Theory
- CLT : Cognitive Load Theory



UMS  
UNIVERSITI MALAYSIA SABAH

## LIST OF APPENDICES

Appendix 1: Experimental Materials .....	251
Appendix 2: Experimental Tasks .....	254
Appendix 3: Data Analysis and Result .....	257



**UMS**  
UNIVERSITI MALAYSIA SABAH

# CHAPTER 1: INTRODUCTION

## 1.1 Background of Study

XBRL (eXtensible Business Reporting Language) is an advance approach for business and financial reporting in a digital platform which is also known as Internet Financial Reporting (IFR). XBRL was established to address the limitations of traditional financial reporting, which is more static and has limited search capabilities (SEC, 2009). For example, the use of HyperText Markup Language (HTML), Portable Document Format (PDF), Word, and Excel in financial reporting (Janvrin et al., 2013; Perkhofer et al., 2019) does not fully support users or financial analysts in decision-making, as static financial information representation is not fully machine-readable (Rowbottom et al., 2021). Thus, it requires users perform additional work to acquire financial data for analyses and judgments (Kelton et al., 2010; Boritz & No, 2003).

On the other hand, XBRL, which is built using a standard electronic language based on an open XML (eXtensible Markup Language) (Ilias et al., 2021), facilitates the development of interactive data visualisation (IDV) (Debreceeny & Gray, 2001). IDV is one of the emerging cognitive technologies that enable users to leverage data to reach new insights which can affect a range of tactical and strategic decisions (Deloitte, 2017). The IDV features such as navigation (which comprises hyperlinks) (Kelton & Pennington, 2012) has changed how financial information is presented and accessed by the users (Plumlee & Plumlee, 2008). Interestingly, IDV also allows users to control how information is presented during their decision - making processes (Luo, 2019). Therefore, XBRL with IDV denotes high-level website interactivity and is distinguished from the other forms of IFR mentioned above which depict low-level website interactivity (Dilla et al., 2010; Ghani et al., 2011; Janvrin et al., 2013; Scarlata et al., 2019).

XBRL, as a high-level interactive website, claims to better support users in their decision-making process by minimising their cognitive load in dealing with complex financial information (Dilla et al., 2010, 2013; Dilla & Raschke, 2015; Engin & Vetschera, 2017; Lambert et al., 2019; Perdana et al., 2018a, 2018b; Vessey, 1991). This results in users' satisfaction for ease of use (Ilias, Ghani, Baidi & Rahman, 2020; Kelton & Pennington, 2012; Perkhofer et al., 2019), thereby optimising their search strategy, information acquisition and usability, (Perdana et al., 2018a, 2018b; Scarlata et al., 2019). As a result, XBRL has become significantly more favourable to users compared to other forms of IFR (Ghani et al., 2011; Janvrin et al., 2013; Scarlata et al., 2019). Thus, researchers have advocated for the use of IDV in financial reporting to assist users in making financial analyses and judgements (see Janvrin et al., 2013; Perdana 2018a, 2018b; Dilla et al., 2010, 2013).

Nevertheless, despite the enormous benefits and the potential applications of the IDV (Chang & Luo, 2019; Dilla et al., 2013; Dilla & Raschke, 2015; Luo, 2019; Maas & Verdoorn, 2017; Perdana et al., 2018a, 2018b), little is known about how this IDV affects users' cognitive load during decision-making (Scarlata et al., 2019). Therefore, recent studies of accounting and information systems (AIS) have emphasised the importance of further research on the effect of IDV in disseminating information to users for decision-making (Dilla et al., 2010; Maas & Verdoorn, 2017; Perdana et al., 2018a; Scarlata et al., 2019).

When it comes to user decision-making, there are two major components to consider: the processes and the outcomes. The former frequently relates to decision optimisation and well-informed earnings forecasting decisions. Whereas the latter reveals how users interact with financial information presented in the IFR (Dilla et al., 2010). The literatures have documented that the IDV has a positive impact on user decision-

making outcomes, such as increasing users' accuracy in predicting future earnings, increasing users' willingness to invest, and allowing users to make more timely decisions (Dilla et al., 2013; Lambert et al., 2019, Perdana et al., 2018a, 2018b).

However, the decision-making literature does not adequately account for the effects of IDV on decision-making processes. Although the effect of IDV on users' decision-making processes can be deduced by examining their satisfaction (Adipat et al., 2011; Dunn & Grabski, 2001) and their ability to collect relevant data or perform heuristic information processing while interacting with the IFR (Perdana et al., 2018a), such effects remain inconclusive as only few works have been published which provide insight on the effect of IDV on users' decision making processes in the accounting field (Dilla et al., 2010; Locke, 2015; Perdana et al., 2018b).

Hu et al. (2017) emphasised the significance of looking into how users' satisfaction with website navigation impacts their ability to make decisions. Additionally, information usability is a key factor in predicting an effective information representation that gives users a better experience during decision-making processes (Perdana et al., 2018a; 2018b). Furthermore, Sundar et al. (2015) claimed that web navigation structures (the presence of hyperlinks) may affect users' cognition and information usability, which may result in better information processing. While the IDV is a relatively new concept in the accounting field (Locke et al., 2015), therefore more knowledge is needed to shed a light and improving the existing understanding of IDV in the context of IFR.

Apart from that, regarding users' financial analyses and judgement, which frequently refer to task characteristics (simple or complex task) (Luo 2019; Tang et al. 2014; Perdana et al., 2018b), researchers have empirically demonstrated that they influence users' decision-making processes. Different task complexity levels have been shown to affect users' cognitive loads differently, hence, so do their choices over information

representation when making financial analyses and judgements (Luo, 2019; Tang et al., 2014). Furthermore, such information representation choices have been shown to be contingent upon users' characteristics, particularly their knowledge domain and experiences (Dilla et al., 2010, 2013; Dilla & Raschke, 2015; Engin & Vetschera, 2017; Janvrin et al., 2014; Perdana et al., 2018a, 2018b).

Nonetheless, the existing research documented inconsistent findings on the relationship between the IDV, task characteristics as well as users' characteristics. Such inconsistencies could be because IDV is still a relatively new to financial reporting in comparison to other fields such as marketing, information science, and the health industry (Locke et al., 2015; Marty, 2009; Niu et al., 2021; Oh & Sundar, 2015). Hence, additional research into the role of IDV in decision making, particularly the processes is crucial (Cardinaels, 2008; Cardinaels & van Veen-Dirks, 2010; Flood et al., 2016; Jones et al., 2020; Maas & Verdoorn, 2017).

Additionally, scholars accentuated that users' financial analyses and judgement or known as the task characteristics, often categorised as simple or complex tasks (Luo 2019; Tang et al. 2014, Perdana et al., 2018b) affect users' decision-making processes. Different task complexity levels affect users' cognitive loads differently, and so do their choices over information representation while making financial analyses and judgments. Moreover, such information representation choices are proven to be contingent upon users' characteristics, particularly their knowledge domain and overall experience (Dilla et al., 2010, 2013; Dilla & Raschke, 2015; Engin & Vetschera, 2017; Janvrin et al., 2014; Perdana et al., 2018a, 2018b).

Therefore, this study is motivated to investigate the effects of IDV on users' cognitive loads and decision-making processes through experimental research design. Researchers emphasised that analysing the impact of information representation on users' cognition

and decision-making processes is best guided by Sweller's Cognitive Load Theory (CLT) (1988, 2010, 2019) and Shaft and Vessey's Cognitive Fit Theory (CFT) (2006) (Dilla et al., 2010, 2013; Luo, 2019; Shaft & Vessey, 2006; Vessey & Galletta, 1991) because these two theories are related to human cognition in problem-solving and decision-making.

CLT is needed to grasp the condition and application of cognitive loads in a user's decision-making process. CFT explains how technological tools like IDV may better assist users in problem-solving, which enhances a user's decision-making process and performance. Hence, this study uses these two theories to lay the groundwork for comprehending the functions of IDV in XBRL reporting to capture the mental resources needed to complete a task, measured by cognitive load and visualisation design decisions (Szafir et al., 2016).

This study is significant as it contributes to further understanding of the usefulness of IDV in decision-making processes by providing empirical and novel evidence for evaluating the claims of XBRL's efficacy through IDV (Gunn, 2007; Srivastava & Liu, 2012; Scarlata et al., 2019). Moreover, since only a few experimental studies have investigated the potential benefits of XBRL, particularly IDV, to financial statement users (Scarlata et al., 2019), this research contributes to research methodology in the accounting research field in IDV and financial information representation research.

## **1.2 Scope of Study**

The scope of this study is based in Malaysia, which implemented XBRL financial reporting standards in 2015 (Ilias et al., 2020). The XBRL adoption mandate was initiated by the Suruhanjaya Syarikat Malaysia (SSM) (Ilias et al., 2021), with the mandate viewed as a step toward further strengthening Malaysia's IFR (PwC, 2019). This is consistent with the national agenda of transitioning to a digital economy and business automation,