

## USING THE TECHNOLOGY ACCEPTANCE MODEL TO ANALYZE THE LIKELY IMPACT OF MICROSOFT'S REPORTING SERVICES PRODUCT

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### ABSTRACT

The introduction, by Microsoft, of their Reporting Services product is likely to have a major impact on the Business Intelligence industry. By bundling the two technologies with its SQL Server product, Microsoft will leverage the large user base of this database management tool to grow market share for its Business Intelligence products. In this study, a modification of the Technology Acceptance Model is used to better understand existing and potential users' decision on whether or not to adopt Reporting Services product. The idea of 'critical mass' is tested, and found to be not particularly important to individual adoption choices.

**KEYWORDS:** Technology Acceptance Model, Microsoft Reporting Services, Business Intelligence, Critical Mass, Social Influence, Technology Adoption

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## 1. INTRODUCTION

It has been estimated that the BI market is currently worth more than US\$7 billion dollars and could double by 2006 [1]. Microsoft has developed an extensive range of software products targeted specifically at this profitable industry segment. One of these products, Analysis Services, has, only a few years after its introduction, become the market share leader in the on-line analytical processing (OLAP) server market.

Recently, Microsoft has introduced a companion product called Reporting Services aimed at the larger enterprise reporting market, currently dominated by products such as Business Objects' Crystal Reports. This paper describes the results of a study of Australian BI professionals that examines the potential impact of the introduction of this product on the BI market using Davis, Bagozzi and Warshaw's [2] technology acceptance model (TAM). The paper is structured as follows. The next section briefly describes BI and the current status of the BI market and is followed by a short description of TAM. Next, there is description of the methodology used in the study and an analysis of the results. Finally, the implications are discussed.

## 2. BACKGROUND AND THEORY

### 2.1 Business Intelligence

The concepts that are today associated with business intelligence initially evolved at IBM during the mid to late 1980s. Devlin and Murphy [3] described the architecture used internally within IBM to provide an integrated cross-functional data source for management reporting. Figure 1 shows a simplified business intelligence architecture. In order to provide an integrated view of the "business," data must be sourced from a variety of different application systems. These might include legacy application systems, enterprise resource systems, general ledger systems and even some spreadsheet and personal database systems. This data has to be extracted and transformed before it can be loaded into the data warehouse [4]. Once integrated in the data warehouse, the data is available for use in support of decision-making activities.

As shown in Figure 1, users and applications access the data warehouse using reporting, analysis and data mining applications.

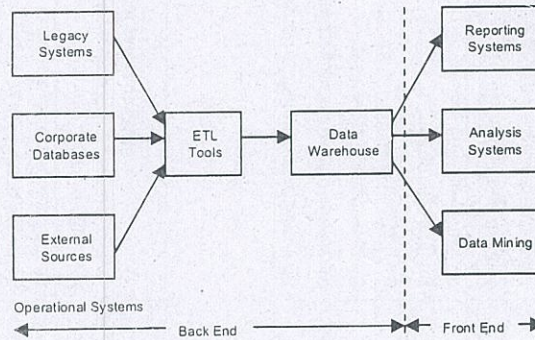


Figure 1: Business Intelligence Architecture

The aim of the business intelligence reporting systems is to allow the end-user to explore the data in an intuitive manner. The end-user should be able to examine the data available and investigate areas of concern as they are identified. A typical interactive session might be with a user studying a summary report of sales for a number product groups for a geographic region. The report might include a graph and the numbers in a table might be color coded to indicate whether predefined budgets have been achieved. After noting a product group of concern the user might be able, by 'clicking' on that product group on-screen, to simply obtain a new report with more detail about that specific product group.

## 2.2 Current Status of BI market

Microsoft claims that their new front-end Reporting Services tool supports the entire BI reporting lifecycle, which consists of report authoring, management, and delivery. Users can manage, schedule and publish reports, resource definitions and folders as a web service, for delivery in a variety of formats, such as portable document format (PDF) or a standard web page [5].

Microsoft plans to include Reporting Services in the next version of SQL Server at no additional cost. It would be reasonable to expect this to make Microsoft Reporting Services likely to be adopted by many BI users. As the number of users of Microsoft Reporting Services increases, it will become increasingly valuable and attract more users to adopt this technology because the users can take advantage of increased compatibility, ease of collaboration, product support and information availability.

In the past, programmers and database administrators working on the Microsoft SQL Server platform had problems in creating and distributing reports. Microsoft SQL Server users have had to use other tools (such as Crystal Reports) for their reporting needs. Whilst this has meant a close relationship between Crystal (now Business Objects) in the past, the production by Microsoft of a 'free,' directly competitive product may affect this previously close relationship.

Microsoft's size, its partner network, training programs, and the ability to leverage existing markets are important factors that will contribute to the adoption of Microsoft Reporting Services.

Variables	Definitions
Actual system use	The level of technology use, which is the degree to which an individual has integrated a technology into their work environment.
Perceived usefulness	The user's perspective that using a particulate system will increase his or her performance.
Perceived ease of use	The degree to which the BI user believes that using a BI system will be free of effort.
Subjective norms	The normative beliefs that an individual attributes to what influential persons expect him to do with respect to using the technology.
Critical mass	The effect of network externality on IT adoption and innovation, which lead to the fact that the value of technology increases with the number of its adopters.
Attitude towards use	An individual's feelings of favourableness or unfavourableness towards using a BI system.
Behavioural Intension to use	An individual's intentions towards behaviour that might enhance their work performance.

Table 1: TAM variables

### 2.3 TAM

One of the most challenging issues in Information Systems research is to understand why people accept or reject computer technology [2]. If users perceive that a BI system is difficult to use and adds no significant benefit to their ability to act or make decisions, they will probably either reject or use minimize its use.

		f	%
Job Category	IS	62	78.5
	Non-IS	17	21.5
	Total	79	100.0
Industry	IT	31	39.2
	Non-IT	48	60.8
	Total	79	100.0
Type of use	Developer	59	74.7
	User	20	25.3
	Total	79	100.0
Number of People Report To	0-5	68	86.1
	6-50	10	12.7
	> 50	1	1.3
	Total	79	100.0
Years of Computer Experience	< 1 year	3	3.8
	1-10 years	41	51.9
	11-20 years	27	34.2
	> 20 years	8	10.1
	Total	79	100.0
Months of RS Experience	0 months	34	43.0
	1-10 months	39	49.3
	> 10 months	6	7.6
	Total	79	100.0
Average Weekly RS	0 times	34	43.0
	1-15 times	42	53.2
	> 15 times	3	3.8
	Total	79	100.0

Table 2: Demographic Frequency Table

Davis [6] originally proposed the TAM model, arguing that perceived usefulness and perceived ease of use are fundamental variables that impact a users' attitude toward using the system. Attitude toward using the system determines behavioral intention, which influences the actual system use

TAM is strongly grounded in existing psychological theory. It is also simple and cost-effective to apply, making an explicit link to the concept of usability in ease-of-use construct [7]. TAM has been widely replicated in many studies that use different tasks and tools and it has been found to be extremely robust [8]. Davis et al. [2] found that TAM can be used to predict software usage intention better than the competing Theory of Reasoned Action [9]. Davis et al. [2] tested TAM and found that individuals rely on both their perceptions of usefulness and ease of use to form their behavioural intention, which can predict adoption behaviour.

In this study the basic TAM model has been extended for investigating the acceptance and actual use of Microsoft Reporting Services. The theoretical model incorporates the social factor variables from TRA, in the hope of more fully understanding BI system adoption. Table 1 describes the variables of this extended TAM in detail.

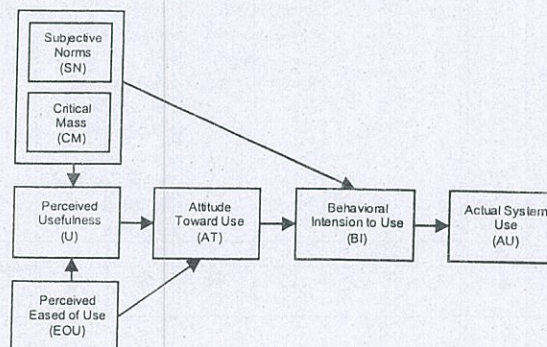


Figure 2: The Extended TAM

### 3. METHODOLOGY

An online survey of the use of Microsoft Reporting Services on the BI market was conducted in 2004. The survey instrument was pilot tested using four data warehouse professionals who have experience in using Microsoft Reporting Services and one online questionnaire expert to test the questionnaire. Their feedback was used to identify programming errors and modify the

online questionnaire. Participant feedback, collected from the pilot group, framed the final version of the questionnaire.

An e-mail containing information about the project was sent to an e-mail list of BI users maintained by the Data Warehouse Association of Australasia (DWAA). A total of 79 subjects responded by accessing the URL and filling out the survey questionnaire. They were drawn from a variety of industry, job categories, types of user, work positions, months of MS Reporting Services experience and average weekly MS Reporting Services use as shown in Table 2.

#### 4. RESULT & ANALYSIS

Table 3 reports the test results and the regression statistics used to examine the relationships between the variables in this study. According to the results, perceived ease of use, subjective norms and critical mass have a significant influence on perceived usefulness ( $p < .05$ ). Both perceived ease of use and perceived usefulness have a significant influence on attitude towards use ( $p < .05$ ). Subjective norms and attitude towards use have a significant influence on behavioral intention to use ( $p < .05$ ). However, there is no statistically significant relationship between critical mass and attitude towards use ( $p > .05$ ). Finally, behavioral intention to use has a significant positive influence on actual use of the system ( $p < .01$ ).

Relationship	$\beta$	Standard Error of $\beta$	t	p	$R^2$	Result
EOU $\rightarrow$ U	.262	.079	2.902	.005	.547	Supported
SN $\rightarrow$ U	.434	.085	4.790	<.001	.547	Supported
CM $\rightarrow$ U	.241	.076	2.788	.007	.547	Supported
SN $\rightarrow$ EOU	.378	.115	3.548	.001	.259	Supported
CM $\rightarrow$ EOU	.226	.108	2.120	.037	.259	Supported
EOU $\rightarrow$ AT	.270	.076	3.660	<.001	.714	Supported
U $\rightarrow$ AT	.665	.087	9.033	<.001	.714	Supported
SN $\rightarrow$ I	.603	.107	7.017	<.001	.696	Supported
CM $\rightarrow$ I	-.011	.085	-.145	.885	.696	Unsupported
AT $\rightarrow$ I	.306	.102	3.387	.001	.696	Supported
I $\rightarrow$ ASU	.579	.085	6.2256	<.001	.335	Supported

Table 3: Regression Result

In summary, results from this study firmly supported -- with one exception -- the current theoretical model derived from TAM. There is no significant relationship existing between critical mass and behavioral intention to use ( $p > .05$ ). In addition, the amount of variance explained (indicated by  $R^2$ ) for each variable was high, ranging from 26 to 71 percent.

The results of this study show that behavioral intention to use is an important variable that determines actual Microsoft Reporting Services use ( $\beta = .579$ ,  $p < .001$ ). This may suggest that users are driven to accept Microsoft Reporting Services principally based on their intention to use the technology or individual beliefs that using Microsoft Reporting Services will enhance their performance. This finding is consistent with results from prior studies that used TAM such as Davis et al. [2] and Taylor and Todd [10], which found the mediated effect of user's intention to use on actual the use of an information system.

According to the results, intention to use Microsoft Reporting Services is affected by two major factors: subjective norms and user's attitude towards using the technology. The results show the significant effect of subjective norms on user's attitude towards using the technology ( $\beta = .603$ ,  $p < .001$ ). However, the most surprising finding is that critical mass does not significantly influence a user's intention to use the technology. Prior research conducted by Hsu and Lu [11] indicate that critical mass has a significant effect on behavioral intention to use.

The results report that both perceived ease of use and perceived usefulness significantly influence a BI user's attitude towards using Microsoft Reporting Services. Perceived usefulness has a greater effect on attitude towards use ( $\beta = .665$ ,  $p < .001$ ) than perceived ease of use ( $\beta = .270$ ,  $p < .001$ ). This may imply that BI user's attitude to use Microsoft Reporting Services is primarily based on usefulness because of the functions that Microsoft Reporting Services perform for them.

The relationship between perceived ease of use and perceived usefulness and attitude towards use reported in this study is consistent with several prior research such as Chau [12], Morris

[7] and Davis et al. [2], which also reports the greater effect of perceived usefulness on attitude towards use.

Social influence including subjective norms and critical mass directly, significantly and separately influence perceived ease of use of Microsoft Reporting Services. The results present a significant effect of subjective norms on perceived ease of use ( $\beta=.378$ ,  $p<.01$ ) and a moderate effect of critical mass on perceived ease of use ( $\beta=.226$ ,  $p<.05$ ). One of the possible reasons is that since supervisor and colleagues support the use of Microsoft Reporting Services, they might provide BI users with financial resources, time, information, technical support, training and other resources, which make Microsoft Reporting Services easier to use. Another possible reason is that when Microsoft Reporting Services becomes more conventional, BI users can easily obtain information needed and help from their supervisor and colleagues. This would cause BI users to perceive Microsoft Reporting Services to be easier to use. Users' perception of Microsoft Reporting Services' usefulness is significantly affected by perceived ease of use ( $\beta=.262$ ,  $p<.01$ ), subjective norms ( $\beta=.434$ ,  $p<.001$ ) and critical mass ( $\beta=.241$ ,  $p<.01$ ). As the number of users of Microsoft Reporting Services increases, this product will likely become increasingly valuable and attract more users to adopt the technology. This makes BI users easy to collaborate with other people that currently use Microsoft Reporting Services. In addition, the user-friendly interface of Microsoft Reporting Services also plays a crucial role in determining BI user's perception of usefulness. If the difficulty of use cannot be overcome, then the BI user might not perceive the usefulness of the BI system and might have negative attitude towards use and consequently affect the intention to use that BI system. he or she might then reject to use the system

## 5. CONCLUSION & DISCUSSION

### 5.1 Implication for Researchers

This study has shown that the extended TAM is a useful theoretical model in helping understand and explain the use of Microsoft Reporting Services.

Although the extended TAM can be used to determine a user's intention to adopt or reject a BI system by suggesting that system's usefulness, ease of use and social influence are important influential factors, TAM cannot give advice how to improve the system in order to increase the degree of system adoption. For example, TAM may predict that a BI system would not be used because the potential BI users believed the system is not useful; however, TAM cannot tell developers what to change to increase usefulness. Likewise, while TAM indicates that a BI system is difficult to use, it cannot tell developers what would make the system easier to use.

Results from the empirical study also show that there is a significant effect of perceived ease of use and social influence including subjective norms and critical mass on perceived usefulness. Both subjective norms and critical mass influence perceived ease of use, and user's perceptions of this technology's usefulness and ease of use have a significant effect on attitude towards use. Subjective norms and users' attitude towards use affect behavioral intention to use and users' behavioral intention to use affects actual use of Microsoft Reporting Services.

## **5.2 Implication for Practitioners**

The extended TAM theorizes that perceived usefulness, perceived ease of use and social influence are key determinants that contribute to use of Microsoft Reporting Services. Microsoft can exploit benefits from its dominance status such as lower prices, compatibility, ease of interface, vast budget to invest in promotion and advertisement and acquiring and partnering with existing companies. These advantages of Microsoft can meet all three key determinants that influence the use of Microsoft Reporting Services. Therefore, it is reasonable to expect that Microsoft Reporting Services will be widely adopted in the BI market. That being said, the decision to adopt, at least at this stage, is not being influence by other users' technology adoption choices.

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