

What makes ICT implementation successful: A case study of online assignment submission

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The use of Information and Communication Technologies (ICTs) to support learning and teaching is becoming ubiquitous within open and distance learning. This paper examines the successful implementation and adaptation of an online assignment submission system over a period of twelve years. It draws on this experience and the Technology Acceptance Model (TAM) to identify the factors, which contributed to the system's success. It shows that the TAM categories of perceived usefulness and perceived ease of use offer a good explanation for the success. It also argues that the emergent development methodology used helps create these perceptions.

Introduction

Online assignment submission and management (OASM) can be defined as the use of information and communication technologies (ICTs) to support the submission, marking and return of student assignments (in this case, not including online quizzes). Due to the characteristics of distance education, particularly the geographic distance between student and teacher, there has been widespread interest and use of OASM. The literature describing the use of OASM, however, is limited primarily to system descriptions and reports of initial, limited use (Jones & Behrens, 2003).

Online Assignment Submission, Infocom System (OASIS) has been in use at the Faculty of Informatics and Communication (Infocom) at Central Queensland University (CQU) for five generations and twelve years. The system has evolved from a manual email-based system used by a single academic in 1994 to an advanced web-based system providing a range of additional features and integrated with a number of enterprise systems. In recent times, OASIS has become the most widely used application of ICTs to support teaching and learning within the faculty. In 2004 alone, over 5700 students and 208 markers from sixty-five course offerings used the system to submit, manage and mark over 23,000 assignments. By September 2005 over 6800 students used OASIS to submit an assignment. For the first time, in 2005, the number of students using OASIS has exceeded the number using online quizzes.

In earlier work (Jones & Behrens, 2003), a model of the evolution of OASIS was developed. The aim of this work is to investigate the factors that have contributed to its success. Why has this system become so popular? Why has OASIS taken so long to become widely used? Can we draw any lessons from this system to help improve other applications of ICTs in open and distance learning? This is seen as particularly useful and relevant as the use of ICTs become ubiquitous in open and distance learning.

This paper starts by explaining our research approach, a longitudinal case study, and why we have adopted it. Background on the evolution of the OASIS system is then provided including usage statistics and a summary of recent developments. It then discusses the information systems research literature concerning the success of ICTs. Based on this literature and evidence from the case study factors are identified which have made OASIS a success. The paper closes with a discussion of some potential implications and conclusions.

Research methodology

The main aim of our research was to develop an understanding of what makes for a successful application of ICTs. OASIS was chosen for three main reasons:

1. Long experience and in-depth knowledge of OASIS.
All the authors have been heavily involved, as developers, users, and researchers of OASIS. Two of the authors have been involved for the full twelve-year lifespan of OASIS.
2. Long period of limited adoption followed by widespread adoption.
For a number of years OASIS was used by only a small number of courses and students. From 2001 to 2005 OASIS has gone from being used by 15 per cent of students to over 70 per cent of Infocom students and 65 per cent of Infocom academic staff. It is now the most widely application of ICTs to support learning and teaching.
3. Contribution to the literature.
Most of literature around online assignment submission is limited to describing system features and initial use in a small number of courses (Jones & Behrens, 2003). OASIS though, has been used by 15,000+ students, 430+ staff in 230+ course offerings over a period of twelve years.

The decision to adopt OASIS is made by the academic staff member in charge of a course. Students are unable to use OASIS unless this decision has been made. Once OASIS has been adopted in a course all students in that course are expected to use OASIS for assignment submission. Due to the central role of academic staff in the adoption decision this research focuses on the perceptions of academic staff. Subsequent research will investigate the perceptions and experience of students.

This study employs a longitudinal case study. Data sources used to track the twelve-year operation of OASIS includes participant observation, interview transcripts and survey responses, papers written about OASIS and system logs and databases.

The long and varied experience of the authors with OASIS provides access to a range of documents, discussions, and reflections about OASIS that would normally not be available. Some of this work resulted in two publications. The authors' early experience with OASIS is described in Jones and Jamieson (1997). A model to explain the changes in OASIS (1994–2002) is explained in Jones and Behrens (2003).

As a major ICT used by Infocom the OASIS system's usage is recorded in a sequence of system logs and databases. Since 2002, a helpdesk system provides a record of all support requests associated with OASIS.

In late 2002, a series of six semi-structured interviews were undertaken with full-time academic staff using OASIS. In 2005, two web-based surveys drew on the Technology Acceptance Model (TAM) literature (Davis, 1989; Venkatesh et al., 2003) to investigate perceptions of academic staff. One survey for staff users of OASIS received ninety-four responses for a 34.9 per cent response rate. The second survey targeted staff yet to use OASIS and received eighteen responses for a 15.3 per cent response rate.

The TAM has been adopted as the theoretical framework within this paper. It draws heavily on the responses to two open-ended questions from the web-based surveys that concentrate on the key TAM attributes, perceived usefulness and ease of use. The other data sources have also been used to identify indicators related to these attributes.

As a single, in-depth case study, possible concerns may include a lack of objectivity and limited scope to generalise the results. As part of our research design we maintained as much objectivity as possible by having each researcher separately review the evidence as part of the data analysis phase. The use of TAM, a widely researched and accepted model from the Information Systems literature, should help broaden the findings to other cases of ICT implementation.

Development of OASIS

The Faculty of Informatics and Communication at CQU offers courses in multiple disciplines including: information technology, mathematics, information systems, multimedia, journalism, communication and cultural studies. During the two main terms of 2005 Infocom offered 198 undergraduate and postgraduate (excluding research masters and PhD courses) courses. Over 9500 students were enrolled in these courses. The largest course had 1803 enrolled students studying at nine campuses including distance education. On average an Infocom course in 2005 had 163 enrolled students studying at five campuses.

CQU students are spread geographically across five campuses within Central Queensland (Bundaberg, Emerald, Gladstone, Mackay and Rockhampton), four other Australian campuses run by a commercial partner (Brisbane, Gold Coast, Sydney and Melbourne), a number of overseas locations run by various commercial partners (including Fiji, Singapore, Hong Kong and China) and via distance education. In the first major term of 2005, around 69 per cent of Infocom students studied at the commercial Australian campuses, 18 per cent were distance education students, almost 12 per cent studied at the Central Queensland campuses and 0.8 per cent studied with other partners.

The origins of OASIS can be traced back to the desire to reduce assignment turnaround times for distance education students through the use of email in 1994 (Jones & Jamieson, 1997). From 1994 through to the end of 2002 the OASIS system went through five different generations of development summarised in Table 1 and described in detail in Jones and Behrens (2003). This section focuses on the on-going changes that have occurred since the start of 2003.

Table 1 OASIS evolution: 1994-2005

Generation	Description	Usage
1994–1995: Manual email	Students email assignments to lecturer, who forwards to marker	1 course, 20 distance students
1995–1996: Automated email	A program receives assignments, acknowledges submission, maintains a web page and forwards to marker	2 courses, 50 students
1996: Unintegrated web	Students submit via web page, not integrated with enterprise systems	2 courses, 100 students
1997–2000: Integrated web	Web submission system integrated with student records	8 courses, 1800+ assignments
2001–now: Evolutionary development	The system undergoes regular changes to improve and extend functionality	See Figure 1

During 2001 the development team (the Infocom Web team) supporting OASIS, and other ICTs within Infocom, entered a new period where resources and support were at a significantly higher level. OASIS is but one part of a large collection of integrated ICTs that are developed and supported by the Infocom Web team. This larger system, under the title Webfuse, has been under development since 1996 (Jones & Buchanan, 1996) and since 2001 the team has used an emergent development process with an adopter-based focus (Jones, Lynch & Jamieson, 2003). This process has contributed to the on-going evolutionary development of OASIS. Table 2 provides a summary of the enhancements made to OASIS since the start of 2003.

Table 2 Modifications made to OASIS: 2003–2005

Date	Feature	Description
Early 2003	Special topic support	A special topic course has a single course code used by multiple courses.
Early 2003	Staff responsibilities	Integration with a teaching responsibilities database (from CQU's commercial partners) to automatically update which assignments a staff member can mark
Late 2003	Limit submission	Limit assignment submission to a specific list of students within a course (rather than all students)
Late 2003	Updated virus detection	New, less resource intensive enterprise system used
Late 2003	Peer review	Interface to enable students to anonymously review the assignments of other students
2004	Upload progress	Provide better feedback about the progress of assignment submission (upload to server)
2004	Speed optimisation	Limitations of server speed contributed to a number of changes in the technology (e.g., optimisation of process) and practice (staggering assignment due dates)
Late 2004	Staff allocation	Allow coordinators to allocate assignments to specific markers
Late 2004	Plagiarism detection	Streamline detection process
Late 2004	Marks breakdown	Allow students to see results on all assessment items (including exams) via student portal
Late 2004	Collection and uploading improvements	Numerous modifications to system processes for smoother running
Late 2004	Assignment returns facility	Coordinators use this to return assignments (via email) to students, previously a manual process requiring technical support
2005	Plagiarism detection report improvements	To help with increase enrolments.

Figure 1 shows the growth in use of OASIS since 2000. It shows the percentage of courses offered by Infocom using OASIS and the percentage of students enrolled in Infocom courses who have submitted assignments using OASIS. In 2005 (up until September 22) 72 per cent (6851) of Infocom students used OASIS compared to 49 per cent using online quizzes. In the first year quizzes were available (2001) they were used by 38 per cent (3655) of Infocom students in 15 per cent (35) of Infocom courses. In the same year only 17 per cent of Infocom students and 8 per cent of Infocom courses made use of OASIS.

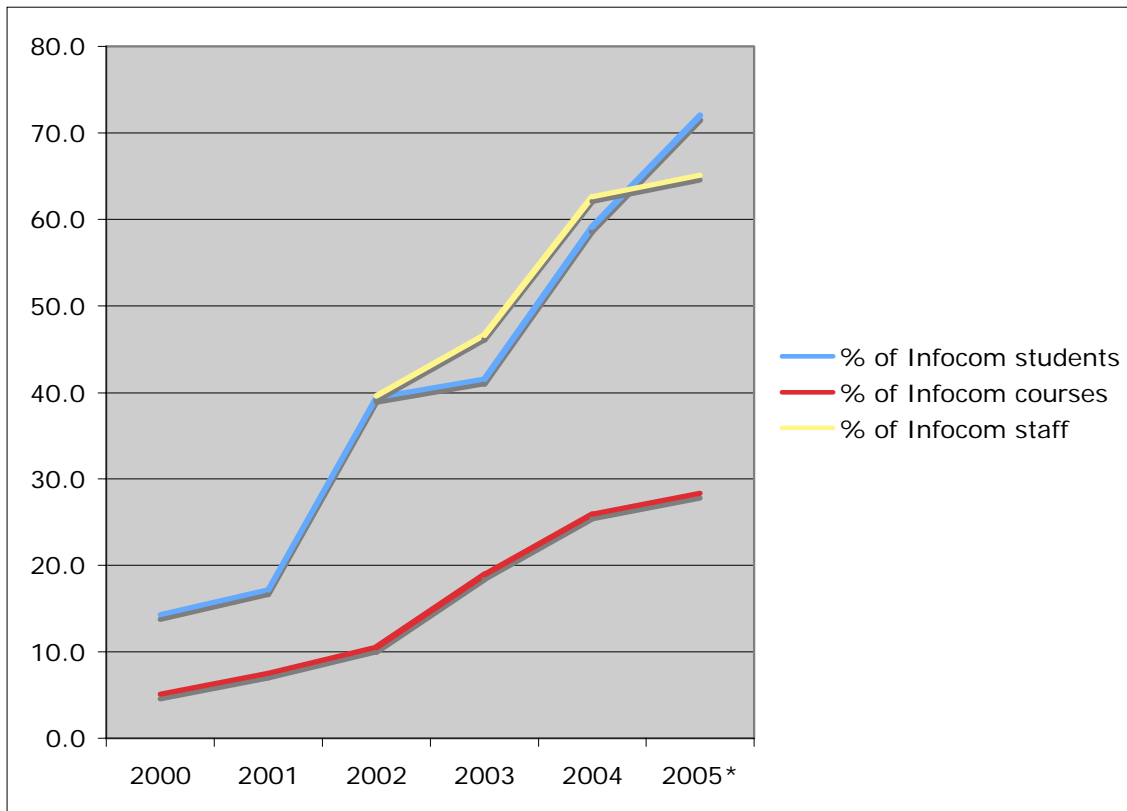


Figure 1 Percentage of Infocom courses, students and staff using OASIS: 2000–2005
 (* 2005 figures only include up to Sep 22. Staff marking database started in 2002)

How do you measure success?

The issue of how to measure success or failure is not easy as the success or failure of a system is seen as a matter of interpretation and that interpretation can change over time (Myers, 1994). Measuring success within information systems (IS) has been a concern for those within the information systems discipline since its inception. Although success is complex and therefore difficult to measure researchers have made efforts in doing so. Traditionally these measurements focus on delivering a functional IS product within certain economic and temporal constraints. ICTs are a specific example of an IS innovation which has been judged in the same light. Despite this bias there is evidence to suggest that a more accurate measure of success may lie within the realms of user acceptance and use.

DeLone and McLean (1992) were leaders in moving to a more user-centred approach when trying to judge overall IS success. Their model suggests six interdependent measurements of success: system quality, information quality, use, user satisfaction, individual impact and organisational impact. It is important to note that all of these factors should be considered when trying to measure success under the model and that no single measure is intrinsically better than any other. Further attempts have been made to refine and expand on their model (e.g., Seddon et al., 1999), however, as DeLone and McLean (1992 p.61) pointed out, ‘there are nearly as many measures of success as there are studies’.

The shift from organisational measures of success to user-focused perceptions has become more noticeable within the IS literature. The work of Davis (1989) on the TAM is a user-centred approach which has gained popularity as a measure of success. TAM suggests that when users encounter a new IS innovation there are two main factors which will influence how and when they will use it.

These are: perceived usefulness and perceived ease-of-use. Perceived usefulness is ‘the degree to which a person believes that using a particular system would enhance his or her job performance’ (Davis, 1989). Perceived ease-of-use is ‘the degree to which a person believes that using a particular system would be free from effort’ (Davis, 1989).

Although TAM has been developed further into a more elaborate model known as the Unified Theory of Acceptance and Use of Technology (UTAUT), also known as TAM2, there currently exists only one study (Venkatesh et al., 2003) confirming its validity and robustness. TAM on the other hand has been tested by many more researchers with different populations of users and IS innovations and is confirmed to be a robust and valid way of determining success. Due to the extensive testing and support of the model by others we have decided to start our analysis using the original TAM proposed by Davis (1989) rather than the extended model of the UTAUT (Venkatesh et al., 2003). In this study we apply the model to the untested area of ICTs with a specific ICT, OASIS in use at CQU to reveal a more accurate picture of why OASIS has been successful.

Why is OASIS a success

With system usage as the metric it is possible to argue that OASIS has, over time, become a success. Why? Why did it take so long to be widely adopted? This section draws on the two TAM factors, perceived usefulness and perceived ease of use, to analyse the case study data and identify those characteristics of OASIS, which aided its success. The following section attempts to draw some implications from these findings for both the future development of OASIS and ICTs more generally.

Perceived usefulness

Table 3 Enablers and barriers to the perceived usefulness of OASIS

Enablers	Barriers
<p>Staff can track the process of assignment submission and marking</p> <p>Easily analyse results from assessment to track student progress</p> <p>Some assignments can be marked more quickly</p> <p>Positive experience with other systems maintained by the same group</p> <p>Helps encourage uniformity of marking</p> <p>Online assignments can be run through plagiarism detection</p> <p>Staff can retrieve, view and manipulate assignments from any location, including home</p> <p>Timely turnaround for students</p> <p>Progress of submission is visible to students at all time</p> <p>Assignment submission is easier for students</p> <p>It provides equality for students regardless of geographic position</p> <p>Ability to compare student performance with others</p>	<p>Some types of assessment are not seen as suitable for online submission</p> <p>It can take longer to mark online assignments</p> <p>Duplication of results storage in students feedback file and central results file</p>

Perceived usefulness is 'the degree to which a person believes that using a particular system would enhance his/her job performance'. Table 3 (above) summarises the factors that staff have identified which contribute to their perceptions of the usefulness of OASIS. As can be seen the enablers significantly outweigh the barriers.

It is interesting to note, though not entirely surprising, that there is a lot of variance in perceptions of OASIS. For example, the following two quotes express completely different views about the influence of OASIS on marking.¹

I was stunned by just how much time was saved by no longer needing to handle piles of paper. Virus scanning 100 floppy disks, for example, takes a long time. OASIS provides a neatly formatted, scanned, and correctly-named set of files.

For assignments that where marking can not be automated it is very time consuming to mark electronic copy, especially when there is significant reading to be done. it is also time consuming to provide feedback.

Marking and whether or not a particular assignment could be submitted electronically are seen as the biggest barrier to the perceived usefulness of OASIS.

I mark all my student's assignments manually, it is easier for me to sub-edit stories that way, so OASIS would probably only add another step to that process

This system may be useful but only in specific cases, or in specific types of assignments, not as a universal tool.

I think we're getting a more uniform marking out of it

Many staff perceive OASIS as useful because of the range of benefits it provides students.

I thought the students could have far more control over what's going and can see what going on

It creates an equality between on-campus students and flex students no matter where they are because they all want to be able to submit at the same time.

These benefits have been available since very early on in OASIS' development. It has, however, only been in recent years when additional benefits for staff have been perceived that usage of OASIS has increased. This has coincided with the steady evolutionary development of OASIS and the increasing complexity of Infocom's teaching.

Submission records for students are useful in monitoring my students' progress, hence adjust tutorials/support as needed.

Very usefull to keep track of people's marks and assignments even after they've been returned etc.

OASIS will allow the assignment submission & collection be more efficient, and will be fair to the students. It will also speed up the marking & moderation process.

Having assignments on soft-copy a tremendous help. No need to carry them home, easier to check for plagiarism – with S/W,

Perceived ease of use

Perceived ease of use is 'the degree to which a person believes that using a particular system would be free from effort'. Table 4 summarises the factors identified that influence their perception of OASIS' ease of use.

Table 4 Enablers and barriers to the perceived ease of use of OASIS

Enablers	Barriers
Experience with other Infocom systems Lack of complaints from others Friendly support staff	Difficulty and time consuming nature of marking electronic assignments Difficulty of interface File structure, zip files for uploading Complaints from others

The adoption of OASIS does require a significant change for staff in the way assignments are collected and marked. Table 4 indicates that the barriers to OASIS ease of use are greater, in quantity, than the enablers. It appears, however, that the combination of the usefulness factors and the enablers of ease of use overcome these barriers, for many, if not all, staff.

Non-users of the system rely on past experience and the rumour-mill to help inform the ease of use perceptions of OASIS, occasionally with contradictory results.

Nobody seem to complain too much about OASIS being hard to use, or hindering them in their job

I have heard from another tutor that OASIS is a bit time consuming and a little confusing.. but have not used it myself.

the precedent of other IT systems made available in Infocom (...) suggests that it would be extremely user friendly for people with very limited computer competence/confidence.

Individual capabilities and experience also play a part.

Being an IT professional, I find it very very easy to interact with.

It should not be difficult for me to learn since I'm computer literate.

Anything computer-mediated always seems to take longer or involve more hassles than expected, at least for me.

While the system is relatively easy to learn (for me), it may well not be for someone not as computer literate.

And again it is possible to identify opposing views.

Learning OASIS for the first time is difficult because the instructions are not very clear. However, it is easy once you get the hang of it.

It used to be a problem, but I've seen the system and supporting documentation improve to the point that I would consider the system fairly easy to use for new users.

Implications

This work suggests that more successful applications of ICT can be achieved when the potential adopters of the system perceive the system to be both easy to use and useful. Some of the developments around ICT in higher education are targeted at fulfilling organisational goals with limited consideration of the perceptions of potential adopters. This can lead to systems that are not used, used in ways not intended or the development of shadow systems (Behrens & Sedera, 2004).

User perceptions are influenced by a range of factors and consequently change as time progresses. Individual factors can also result in very different views. OASIS was designed to help manage the submission and return of assignments. Due to the plethora of approaches to marking and limited resources, the system has never offered significant support for online marking. Instead leaving the question of how to mark electronic assignments to the course coordinator. This combined with differing individual capabilities results in different views concerning the difficulty of electronic marking.

Staff with limited computer experience or those who don't modify practice for the new medium often complain about the complexity and time consuming nature of online marking. Staff who adapt better to the new medium have a different experience. For example, the following statements are from an academic who developed a new approach to marking that integrates with OASIS.

I think we're getting a more uniform marking out of it

I believed I've reduced the time I've taken marking assignments from 20 to 12 minutes.

Based on these findings, there appears to be a need to extend OASIS to offer support for online marking (e.g., Clark & Baillie-de Byl, n.d.) in order to extend the perceptions of usefulness and ease of use.

Traditional methods for the implementation of ICTs attempt to identify all requirements upfront, implement a complete system that satisfies all users and then have a long period of stable use. It would appear from the above findings that the variety and ever changing nature of user perceptions may not be a good fit with this approach to ICT development. The potential problem is that as users' needs evolve they will become frustrated and trapped by the system (Truex, Baskerville & Klein, 1999).

Due to this observation and the analysis above it is suggested that an evolutionary development approach, like that used with OASIS, supports an on-going process of discussion with the users allowing the system to grow and meet their needs as they arise. Such an approach helps build perceptions of usefulness and ease of use and hence enhance the chance of successful implementation of ICT systems.

my positive experience with other Infocom systems gives me confidence that OASIS would be no different. The systems team have a very good track record that inspires confidence

The key to easy use of OASIS is that it is not a off the shelf product that is soooooo generic that it has lost its way as a course delivery tool.

As OASIS grows to handle greater functionality, it certainly makes my job a lot easier.

Finally, there is the notion of whether or not use and the TAM are appropriate methods for measuring success. When discussing the successful application of ICTs in education the literature often defines success as using pedagogical approaches supported by educational researchers (e.g., Mioduser et al., 1999). OASIS has been used, almost entirely, to support traditional assessment practices. The peer review feature, the one OASIS feature which supports an 'effective' pedagogy, was used by a single academic in a small course.

Does this mean that OASIS has not really been successful? Is system usage a poor measure of system success in this context? Does the absence of 'appropriate pedagogical' use of the ICT innovation imply something less than success? Would it be more appropriate to focus on requiring staff to adopt 'appropriate' pedagogies than on developing useful and easy to use systems? Who defines what is appropriate?

Conclusions

One method to measure success of an ICT, drawn from the IS literature, is to focus on system usage and the factors that encourage that use. Drawing on the TAM and data from a single longitudinal case study of the application of ICTs to the management of online assignment submission it has been shown that perceptions of ease of use and usefulness of an ICT do seem to offer one explanation for the increasing use of an ICT.

It appears that the evolutionary development process that has focused on the needs of the potential adopters has encouraged positive perceptions of OASIS and related systems. Consequently there appears to be a case for the argument that this type of development process may offer some benefits in the right context. It may be that an on-going process of developing systems that are useful and easy to use may create a context in which academic staff tend to adopt "appropriate" uses of ICTs.

Notes

- 1 All quotations from the surveys are included verbatim. There are numerous quotes with spelling and grammatical errors.

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