Understanding Information Technology System Project Failure

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Abstract

Failure has been synonymous with many information system (IS) projects over the last twenty years. The aim of this paper is to investigate and understand the reasons for IS project failure. There are a number of issues and challenges that require detailed understanding and examination within the context of an information system. The paper illustrates the fact that IS project failure is not restricted to a single industry, a geographical location and it transcends time. A critical analysis of past literature and empirical study is achieved to develop a deeper understanding of the roots of IS project failure. Having established a number of reasons for failure in IS projects, the author examines a number of high profile IS case studies. This should reaffirm and support the idea that IS project failure is caused by deeper sociological patterns in business and relationships among interested parties. It is known that the roots of IS failure is not caused by technological difficulties alone, but a combination of organisational and functional problems within a business. This research links a number of areas that are of importance in IS failure analysis. The author proposes a framework that identifies twenty critical success factors that are required for project success. These are developed from empirical study and are applied to the case studies. An explanation of these critical success factors can be found in appendix 2.

Keywords: Information system, project failure, Taurus project, ISIS project, NATS project, DIABHS project.

1 Introduction

The high failure rate of information system (IS) projects has been occurring for a number of decades. The author examines a number of case studies involving IS projects and analyses the reasons for their successes and failures. The case studies chosen were taken from projects over the last fifteen years and they are from Ireland, UK and USA. This reduces geographical biasness and also allows the author to examine what progress has been achieved over the years in delivering information systems.

Section two begins with defining an information system. A literature review of research carried out over the last fifteen years on project success and failure is compiled. By mapping out the factors that influence project success or failure the author is able to define a number of critical success factors (CSFs). Section 2.3.2 defines project failure into a number of categories, as it is important to identify how failure is perceived by organisation. This is an important factor, as the level at which failure can occur varies depending on the party who assesses how much the failure is worth to them in terms of financial and competitiveness value. The author proposes a three level failure system in this section.

Section three analyses four case studies (Taurus, DIABHS, ISIS and NATS) of information system development. By applying the CSFs in section two to the case studies, the author should be able to define the level of success or failure the projects achieved. This should also support the evidence that the author has deducted from the literature review in section two. The resulting evidence is then graphed to demonstrate the number of CSFs the case studies possessed.

2 An Information System (IS)

An information system will serve to coordinate the work of many different organisational functions, from back office administration support, to a company's strategic management tool. The information system is the core of any business (Yeo, 2002). It encapsulates and integrates a number of areas of business with an aim to increase efficiency and effectiveness of business practices. The implementation of an information system involves the design, delivery and use of the software systems in the organisation. This should be a strategic decision made by an organisation's management and should incorporate the view that the business practices will most likely be altered when the information system is put in place. Information Technology (IT) is the enabling tool that powers the IS. The IS uses IT, manual procedures, models and knowledge bases and databases (Yeo, 2002). This symbiotic relationship between IT and IS should transcend throughout an organisation, if the organisation is to harness the advantages of an integrated information system.

2.1 Defining an Information System

A definition of the term 'information system' would denote a combination of hardware, communication technology and software design to handle information related to on or more business (Yeo, 2002) and (Flowers, 1996). The author defines an information system as,

"An information system is composed of software,hardware, communication systems and people. It is a critical investment for organisational survival. It increases the efficiency and effectiveness of daily business by integrating organisational processes and structures" (Author, 2004).

This definition indicates the importance of designing, developing and maintaining the correct type of information system for a particular organisation. An information system will influence and manage an organisation's business processes all across its departments or sub-units. If such an investment is to take place, the business practices will most likely need to be redeveloped and redefined. It will change the way an organisation will operate and to harness the benefits of such an investment, it is important to embrace change all across the business structure. It is important for the users to be involved in the design phase, as they will ultimately determine if such an implementation is a success or failure. Section three will identify these important factors, as most management teams do not determine these as crucial steps for information system implementation.

2.2 Mapping critical factors for project success

The table below summarises the literature on project success and failure over the last twenty years. The literature review has covered theoretical and empirical study on the factors that contribute to the success or failure of projects. A number of authors repeat the same critical success factors (CSFs) and a number define different CSFs that they believed to be vital for project success. After analysing the literature, the author found that there were twenty CSFs that should be present during a project's life cycle in order for it to succeed. The reason for this analysis is to identify what CSFs were present in the case studies investigated in section three. This should enable the author to ascertain the reasons for success and failure in the case studies.

Baker et. al. (1983)	***Morris and Hough (1987)***	***Pinto and Slevin (1989)***	***Turner, J. R. (1993)***
• Clear Statement of Requirements • Proper Planning i.e. cost and time estimate • Competent Staff • Clear vision & Objectives (Business Case and Scope) • Hard-Working, Focused Staff • Leadership • Adequate Resources and Funding • Minimum start-up difficulties • Absence of bureaucracy and politics	• Clear statement of requirements • Proper planning • Focussed and competent staff • Adequate resources and funding • Minimum start-up difficulties • Absence of bureaucracy and politics	• User Involvement • Executive Management Support • Competent Staff • Hard-Working, Focused Staff • Delivered to budget, on schedule, and to technical specification • Satisfies the needs of the owners, users, project team and stakeholders • Leadership • Communication and teamwork • Absence of bureaucracy and politics	• User Involvement • Executive Management Support • Focussed and competent staff • Delivered to budget, on schedule, and to technical specification • It satisfies the needs of the owners, users, and stakeholders • Leadership and Teamwork • Absence of bureaucracy and politics
CHOAS REPORT (1994)	***Wateridge, J. (1995)***	***Whitaker, B. 1999***	***Boehm, B. (2002)***
• User Involvement • Executive Management Support • Clear Statement of requirements • Proper Planning • Realistic Expectations • Smaller Project Milestones • Competent Staff • Ownership • Clear vision & Objectives • Hard-Working, Focused Staff	• Project achieves its purpose • It provides satisfactory benefit to the owner • It satisfies the needs of the owners, users, and stakeholders • It meets its pre-stated objectives • It is produced to specification, within budget and on time • It satisfied the needs of the project team	• Good project planning • A strong business case • Top management support and involvement • Schedule time keeping • Keeping within budget • Good estimates • Strong definitions of requirements • Vendor's ability to meet requirements	• Complete requirements • User involvement • Resources • Realistic Expectations • Executive Support • No Scope Extension

Figure 2.1: Literature review of project success factors – *Source: Author*

The next stage of this literature review was to analyse the data and represent it in a mathematical format. This was achieved by designing a matrix, with the success factors on the vertical axis and the literature source on the horizontal. The table below illustrates the CSFs that previous research had identified. The explanations of these factors are explained in appendix 2. By identifying what factors were present in the examined IS projects, the author believes the root of the high project failure will be evident in the statistical analysis.

	Baker et. al. (1983)	***Morris and Hough (1987)***	***Pinto and Slevin (1989)***	***Turner, J. R. (1993)***	***CHAOS REPORT (1994)***	***Wateridge, J. (1995)***	***Whitaker (1999)***	***Boehm (2002)***
User Involvement			●		●			●
Executive Management Support			●		●		●	●
Clear Statement of Requirements	●				●		●	
Proper Planning i.e. cost and time estimate.	●				●		●	
Realistic Expectations					●			●
Smaller Project Milestones					●			
Competent Staff	●		●		●			
Ownership					●			
Clear vision & Objectives (Business Case and Scope)	●				●		●	●
Hard-Working, Focused Staff	●		●					
Project delivers its functionality		●		●			●	●
Delivered to budget, on schedule, and to technical specification		●	●	●		●	●	
Commercially profitable for the contractor		●						
Satisfies the needs of the owners, users, project team and stakeholders			●	●		●		
Project achieves its purpose and objectives				●		●	●	●
Leadership	●		●					
Communication and teamwork			●					
Adequate Resources and Funding	●							●
Minimum start-up difficulties	●							
Absence of bureaucracy and politics	●	●	●					

Figure 2.2: Literature review of project success factors – *Source: Author*

2.3 Understanding IS project failure

In order to ascertain a true understanding of why such a high percentage of IS projects fail (*70% of large-scale IS investment fail, Chaos Report*); we must first analyse the roots of failure and define a clear and precise definition of failure. It is important to define what a project is, as this will allow the author to follow in a logical manner, which will allow an analysis of project failure. This in turn can be built on to understand the high level of IS project failure. A project can be defined as,

> *"An achievement of a specific objective, which involves a series of activities and tasks which consume resources. It must be completed within a set specification, having definite start and end dates"* (Munns and Bjeirmi, 1996).

The definition of a project would suggest an aim towards accomplishing a number of goals/objectives. This is achieved by creating a mission statement. To reach this mission, the project must achieve a number of objectives/goals. Objectives can be used to measure the success of the project. Some important parameters within the goals will be return on investment, profitability, competition and market ability (Munns and Bjeirmi, 1996). These factors that will affect the ability to achieve these goals will be discussed in section 2.3.

> *"A project is accomplished by having a vision and creating a mission. The mission is achieved by creating a number of strategic goals that will contribute to the success of the project. A project is confined within a start and end date"* (Author, 2004).

2.3.1 Defining project failure

In order to define failure in the context of an information system project, failure in a generic context must first be defined clearly. This omits any ambiguity in the context of IS project failure. Project failure in the generic context can be defined as,

> *"Failure is usually in terms of projects that are late or over budget, an inability to fully realize the expected benefits or gain the acceptance and enthusiastic support of users and management"* (Cannon, J. A., 1994).

Similar to many authors on project failure, Cannon describes failure as a number of events that occur within a project that does not enable it to conform to specification and obtains it's mission.

2.3.2 Categories of failure

The author believes that it would be unjust to create an absolute definition of failure. It is more plausible to have a number of degrees of failures. The author proposes this idea in section 2.3.2. A number of authors define four major categories of IS failure (Lyytinen and Hirschheim, 1987), (Yeo, 2002) and (Goulielmos, 2003).

Category of failure	Description of Failure
1. Correspondence failure	The IS fails to meet it's design objectives.
2. Process failure	The IS overruns it's budget or time constraints.
3. Interaction failure	The users maintain low or non-interaction with the IS.
4. Expectation failure	The IS does not meet stakeholders' expectations.

Figure 2.1: Categories of IS failure – *Source: Goulielmos, 2003*

The type of failure and the level of failure must also be defined clearly, as failure can represent different circumstances to different people or organisations. Within IS failure you can have organisational, technical, human… failure. The level at which failure can occur varies depending on the party who assesses how much the failure is worth to them in terms of financial, competitiveness value (Goulielmos, 2003).

The author proposes a three level failure system. This analyses IS failure at three different levels i.e. minor, major and critical. This improves on the previous definitions of failure, as it incorporates the twenty different critical success factors, which were identified from literature over the last twenty years. Level one failure is considered as minor, as the final IS project does still meet its objectives and is completed. Level two failure is major as the IS project does not meet all of its requirements and will not be achieved within budget and on time. There are two scenarios in this case. The project can continue and will be completed, but will have run over its schedule and financial budget. It will also not complete all of its objectives, but the solution is workable. The next section will analyse a number of case studies which would be considered level two failure i.e. NATS and DIA. Level three is critical failure and the IS project does not meet any of its requirements or objectives. It is most likely to be scrapped after running over time and budget. There is also probably no end in sight for the project. The next section also analyses a number of level three project failures i.e. Taurus and ISIS. The levels of failure are cumulative and level three cannot be reached without going through level one and level two failures. At level one the project team should be critically aware of the downward spiral of the IS project. They should be willing to respond effectively to the changing environment that has resulted in level one failure. If the project moves into level two it becomes apparent that the IS project is in major difficulty and is at risk been cancelled, thus falling into level three failure.

LEVEL OF FAILURE		
LEVEL ONE (MINOR)	**LEVEL TWO (MAJOR)**	**LEVEL THREE (CRITICAL)**
Profitability	Goals not all achieved	Scrapped before completion
Poor estimates	Complex solutions	Vendor's inability to meet requirements
Unproven technology	Lack of planning	Client consultation during development stage
Lack of resources	Lack of user involvement	
Lack of features	Lack of resources	
Lack of usability	Lack of commitment	
Lack of project organisation	Unrealistic expectations	
Transparency in IS project	Lack of executive support	
Progress meetings	Changing requirements and specifications	
	Schedule overrun	
	Budget overrun	
	Poor leadership and management	
	Debugging incomplete	
	Lack of ownership and responsibility	
	Too many vested interests	

Figure 2.1: The level of project failure – *Source: Author*

2.4 Summary

The author has examined and defined a number of areas within this section that are important to allow a critical analysis of the IS case studies in section three. Having defined an information system and a three level system of project failure, it is apparent at this stage that a significant amount of research in this area fails to exhaust areas that are crucial in IS project success. The list of CSFs might be extensive, but the author will demonstrate how each single factor contributed significantly to a downward spiral of failure for a number of IS projects.

3 Information Technology System Project: Case Studies

The author defines,

"An Information Technology System (ITS) is defined as an implementation of an information system, using a high degree of technology to implement and sustain the system" (Author, 2004).

The author hopes by analysing a number of case studies that involved Information Technology System (ITS) investment, it can be shown that the high percentage of ITS project failures is not a result of flawed technology, but down to a number of socio-economic and socio-technical problems. The technical issues are but manifestations of deeper social pathologies by social meaning issues at the individual, group and organisational levels of functioning and interacting (Goulielmos, 2003). These social problems occur due to the way people perceive failure in our society. Instead of accepting and learning from failure, people have a tendency not to admit to failure, thus we can never learn from past mistakes. This research should present the fact that ITS project failure has never really evolved into a success, because failure is not accepted and future prevention techniques are not developed, as all the facts are not disclosed.

3.1 Introduction

In the previous section the author introduced critical success factors (CSFs) necessary for project success. These success factors have been drawn from an analysis of research and literature into project failure over the last twenty years. What is clear from this research is that management is not adhering to advice, thus the number of information system projects that fail still remains extremely high. The paper examines four case studies that all required the implementation of the large ITS project. Two of the four case studies resulted in failure (TAURUS and ISIS) and two of the case studies finally succeeded in implementing the ITS (DIABHS and NATS). There are two reasons why the author decided on these case studies. The first is that these case studies reduce geographical biasness, as they are from USA, Great Britain and Ireland. What this demonstrates is that information system project failure is a worldwide problem and is not isolated to a certain demographic region. The other reason is that these information system projects have been taken over a period of fifteen years and this illustrates how little project management has learned from previous failures. As human beings, we ought to strive for an illusive perfection and in doing this we improve ourselves. Project management in information systems lacks this natural progression of improvement and the author hopes to conclude on the reasons for this within the paper. The next sub-sections investigate the case studies and identify the reasons behind their successes and failures.

3.2 Taurus

The aim of the Taurus project was to develop an automated transaction settlement system for the London Stock Exchange. The electronic transmission would enable the securities industry (buying and selling shares) to eliminate paper transactions, known as de-materialisation (Drummond, 1998).

3.2.1 Taurus background

It is important to understand the background of the securities business, before analysis of the failed Taurus project can be understood. Securities involve two processes i.e. dealing and settlement. A trade is dealt when a broker is to buy or sell shares for a client at a specific price. Once a trade is dealt, it must be settled. Settlement involves the transfer of money and shares, amending the company's register of shareholders and either issuing and/or cancelling a share certificate (Drummond, 1998). This system dates back to the eighteenth century and due to the large number of transactions occurring within a day, the paper trail was becoming unmanageable. In 1987 the antiquated paper driven system almost collapsed under the sheer volume of trades resulting from a rising market (Goltz, 1992). The Taurus project began in 1998. The aim was to create a simple system for the large investment houses, which account for over 70% of the value of transactions on the London Stock Exchange.

3.2.2 Taurus project design and implementation

There were a number of factors that contributed to the collapse of the Taurus project. When analysing a project failure, it is considerably hard to get the full truth for the reasons behind the failure. The author contends that by analysing previous research on the Taurus project and reading the news coverage of the story during the implementation stage that it will be possible to deduce a logical conclusion for the failed Taurus project. The project was challenging from the beginning. An 18-month time frame demanded by the securities industry for the completion of the Taurus project was extremely ambitious. The Taurus project involved new untested technology and the complexity of the project from the outset made would make it impossible for the project to be completed within 18 months. The securities industry was extremely diverse and was made up of banks, brokers, company registrars, international custodians and a number of other businesses. Analysing the number of vested interests in this project should have sent an alarming warning to the complexity that was going to be ahead. The first warning came when the original project design called 'Taurus 1' was abandoned due to the broker constituency, who believed that it placed them at a commercial disadvantage. This project could have been completed in six months using tried and tested technology (Drummond, 1998).

The design stage that was initially scheduled for two months lasted two years and there were still conflicts of interest. There were over thirty committees connected to the Taurus project all with their own vested interests in the project. The final design was a hybrid structure comprising of over 17 alternative versions of Taurus welded together to reflect existing business practice. This design was finalised by John Watson who was seconded from a consultancy firm Coopers and Lybrand to direct the project. The CEO of the Taurus project at the time, Peter Rawlings, was opposed to such a solution but was not in a position to stop it (Drummond, 1998). The lack of leadership and the spread of ownership with the Taurus project were evident from the beginning of the project. The best firms and people in the industry headed the Taurus project; power and control were the variables that steered the Taurus project into failure.

The design phase was constantly been changed by securities and with this the complexity of the design grew exponentially. Too much control was given to too many bodies and this lead to constant changes in the software design. It was also believed that the project team understood the legal intricacies of the trading environment, but it became clear that this had defeated them (Drummond, 1996). Even at this stage the number of CSFs needed for project success was lacking significantly. This was a case of spiral death and with the chances of a recovered success been minimum.

One of the most crucial decisions made by the project team was to use off the shelf software. The logic behind this was to speed up the development cycle. This software package was known as 'Vista' and was imported from the USA. This was built around the existing Talisman system, which was in existence since 1979. This meant that Vista 'real time' had to be converted to batch processing. Using state of the art technology and software on hardware that was twenty years old did not seem a very logical approach. The different builds were constantly not matching and it was noted that the re-engineering of the software package at the time of the failure of Taurus cost £14 million. Another design issue that did not propose any logic, but the reason behind it was to speed up the project implementation, was the system design. It was believed that by building the outward part of the system first, and then the central architecture would speed things up and make the interested parties happy. To use the analogy of site construction, this would be like building a house without a foundation. In mid-1991 the board granted a time extension and extended budget, but by 1993, with no visible sight of the finished Taurus project, it was cancelled. The original budget of £6 million and with estimate cost at time of abandonment was £800 million; this was 13,200 % over budget, five years over time and without a viable solution in sight (Drummond, 1998).

3.2.3 Analysis of the Taurus failure

After much analysis of past literature and research on the Taurus project, it has been identified that power, politics and responsibility were the main contributing factors in the failure of the Taurus project (Drummond, 1996), (Drummond, 1999) and (Goulielmos, 2003). The escalation theory that was proposed in Drummond research is quite evident on the surface of business practice during the Taurus project. Although it was clear that the project was an impossible task by October 1991, it continued for another two years before complete termination was announced. This is quite frequent in many failed projects. Escalation was irrational, driven by fear of failure (Drummond, 1999). It is the persistence to deny failure, a socio-economic problem that is widespread across all projects. Firstly, the time scale demanded by securities for the project was an impossible target. The complexity and shared responsibilities between so many parties created a lack of cohesion and teamwork between interested parties. An imbalance between power and responsibility i.e. although the stock exchange had ultimate responsibility for the Taurus project, they did not have the power to stop the securities from interfering with the design. Those least accountable for the project had the greatest influence in the project design. Also, the CEO was unable to halt the project although he was against the proposed plans. This lack of leadership and management had a detrimental affect on the project and the project team. The underpinning problem was that management applied the same principles used in running the organisation to running the project, thus creating a legacy of "development by committee", an inappropriate way of managing system development (Goulielmos, 2003). The project had to deal with conflicts of interests, vested interests, too many parties involved in the development stage and lack of control by management. A system implementation should be thought as a separate entity than the daily running of the business. This separates the politics from the development of the project. The Taurus project was a level three failure as the majority of the critical success factors were not achieved. This is graphically demonstrated in figure 3.2.

3.3 Denver Airport Baggage Handling System (DABHS)

3.3.1 Background to DABHS

The Denver Airport Baggage Handling System (DABHS) was unique in its complexity, novel in its technology and new in its capacity. The Baggage Handling System was to be at the heart of the new Denver International Airport (DIA). The Airport expanded for more than 53 sq miles and had room for 12 major runways. DIA was to be a model for airports of the future. The aim of DABHS was to improve ground efficiency, reduce closeout time for hub operations and decrease time-consuming manual sorting and handling (Donaldson, 2002).

The Airport was scheduled to open on the 31st of October 1993; with all three concourses fully running on the BAE automated baggage-handling system. It finally opened on the 28th of February 1995, 16 months late and $200 million over budget (Donaldson, 2002). DABHS was designed by BAE systems and allows airport planners to design airports of larger size, using narrow corridors and tunnels for baggage where no tug and cart system can run. Labour costs are minimal and is completely automatic and runs faster and more reliably than those using traditional technology.

3.3.2 DABHS project design and implementation

The 'Integrated Automated Baggage Handling System' was originally designed to distribute all baggage from check-in to aircraft, to transfer and arrivals. The delivery system consisted of 9km of conveyors, 27km of track on which circulate 4000 individual radio-control carts or Destination Coded Vehicles (DCVs). The capacity of each track would be 60 DCVs per minute. The conveyor belts would feed a central network of DCVs. The operation of these computers was to be controlled by a network of about 150 computers (Neufville, 1994).

Speed was considered crucial for the commercial success of Denver Airport, by marketing it as a national hub for connecting flights (Neufville, 1994). The baggage handling system was the nucleus for this success. The design should allow the baggage to be transported anywhere within the terminal within 10 minutes (Airport Support, 1993). The most fundamental problems with the baggage handling system designed for Denver Airport, had been predicted by theoretical studies and consultant reports, were avoidable and should not be repeated (Neufville, 1994). This was a high-risk project as it was on a very large scale, with enormous complexity, the newness of the technology and the large number of entities to be served by the system (Donaldson, 2002). Another factor that was not considered, but proved vital was the omitting of a backup system. The planners never provided a fleet of tugs between the check-in facilities and the aircraft (Neufville, 1994).

The initial problems began when the design of the automated baggage handling system was left till two years before the airport was due to open.

Although the automated system was an integral part of the airport system, the design was not considered during the design phase of the airport. This put two constraints on the design of the baggage handling system. Firstly, it would be restricted geometrically i.e. it would have to fit inside the constraints of the passenger terminal. The underground tunnel connecting the terminal to the concourse was a shoehorn shape and was very inconvenient. Secondly, the time it had to be designed and built in was 21 months. This would reduce the ability to test and simulate the final system. The next major problem was the inability of the system to achieve reliable delivery times. To guarantee this it is crucial to control the capacity of the system so that all lines of low have balanced service i.e. line balancing (Neufville, 1994).

The top management drove the planning and negotiation for the implementation of this system. They had limited intimate knowledge of the baggage system technology and the consultants hired to develop the system specification were not responsible for monitoring the implementation of the automated system (Montealegre, 1996). Although a new system was been implemented to serve the whole airport, management practices replicated past practices. The management team failed to redefine the system implementation in relation to its new context. They failed to link the interconnected knowledge base and expertise required for the implementation and to ensure consistency and transparency between technology and the context (Montealegre, 1996). Like so many large scale ITS investment, organisations fail to redefine business practices and its organisational structure in relation to its technology investment, thus not gaining maximum strategic advantage from such an expensive investment.

There were a number of short-term solutions implemented to reduce the complexity of a fully automated baggage handling system. The first was to install an alternative system based on standard conveyor belt technology with delivery of bags to concourses by tugs and carts (Johnson, 1994). This was at a cost of $75 million and was labour intensive and expensive to run (Neufville, 1994). The second solution was to simplify the complexity of the system, by reducing the load output. The automated system would only serve one concourse instead of three. It would operate at half capacity. It would only handle outbound baggage and would not deal with transfer bags. The cart and tug system would be used on the other concourses. This increased capital costs by $35 million on top of the $191 million already spent (Neufville, 1994). Finally, United Airway's (UA) system comprised of 22 miles of track, 3,500 cars, and 55 computers handling up to 30,000 pieces of luggage per day. This was simplified automated version running on concourse B at a cost of $300 million. Continental use a tug-and-cart system on concourse A, but it is expected to go automated in the future. Airlines on concourse C would have an automated system, only if BAE installed new track and UA granted rights for access. The backup system is 100% independent of BAE's system. This was a major reduction in efficiency and effectiveness of the service provided. In the end there were three baggage handling systems instead of one integrated system (Donaldson, 2002).

3.3.3 Conclusion

The author has identified two main areas of that caused the delay in the operation of the automated baggage handling system. Firstly, the newness of the technology increased the complexity of the project and the tight timescale for the implementation of an automated baggage handling system. Secondly, the management of DIA struggled to cope with the understanding of the implementation of a highly complex technological baggage handling system. The DIA management group struggled over time to achieve alignment between the changes that were taking place in the overall project and the operation of the systems that were being implemented. The management failed in its duty to foster an environment of understanding between various stakeholders (future users), management and the use of novel technology (Montealegre, 1996). Although the DABHS project suffered level a two failure, it was a critical component for the airport to operate, so the idea of complete failure was incomprehensible.

3.4 ISIS (ILCUTECH Standardised Information System)

The aim of this section is to understand the socio-economic and socio-technical complexities that drove the ISIS project to its failure. It should prevail that one of the major obstacles for the development of a centralised system within the Credit Union movement was its people.

3.4.1 The Credit Union background and structure

The organisational structure of the Irish League of Credit Unions (ILCU) is very complex. It is important to understand the background of the ILCU before trying to conclude on its failed attempt to implement a centralised Information System (ISIS). Each Credit Union is a distinct legal entity, is regulated by the registrar of Friendly Societies and bound by the Credit Union Act, 1997. ILCU is a non-statutory umbrella organisation that offers administrative, technical and training services (Mangan and Stahl, 2002). The ILCU is comprised of over 500 affiliated Credit Unions, with 2.5 million members and combined assets of over five billion euro (Quinn, 2002). More than 2000 delegates represent all Credit Unions nationwide and these delegates represent individual Credit Unions at the ILCU. The delegates vote in ‘The Chapters’, who are part of the structure of the ILCU. A Board of Directors, who are elected by ‘The Chapters’, governs the ILCU. It was the ILCU Board of Directors who initiated the ISIS Project and urged all Credit Unions to sign up to the Project development (Mangan and Stahl, 2002). The ILCUTECH was founded in 1996 by the ILCU in order to promote the centralised use of technology within the Credit Union movement (Mangan and Stahl, 2002). A voluntary Board of Directors runs each Credit Union. The members at the annual general meeting vote in the Board of Directors. Any person who has an account with the Credit union is automatically a shareholder of that Credit Union i.e. member (O’Connor, 2000).

3.4.2 ISIS project design and implementation

The underlining problem with the Irish Credit Union movement was its inability to incorporate a standardised Information System (ISIS). In 1998 the Irish League of Credit Union’s (ILCU) initiated a project to standardise and centralise the information system used by its members (Mangan and Stahl, 2002). Like so many information system project failures, it was not the underlining technology that causes the failure of the projects. In the case of the ISIS project it was a combination of socio-economic and socio-technical issues that resulted in unsuccessfully implementing an information system (Mangan and Stahl, 2002). Since each individual Credit Union was not governed by the ILCU, the take up of a centralised information system was optional. This non-uniform approach to critical issues that confronted the future of the Credit Union movement was widespread across the country, thus leading to lack of standardisation in software and hardware products (O'Connor, 2000).

In section two the author identifies a list of critical success factors that are necessary for a project to succeed. This section aims to investigate if the ISIS project possessed any of these critical success factors. There were a number of events that occurred over the years that caused the collapse of the ISIS project and a loss of £27 million. It was envisaged that the ILCUTECH service bureau staff would be responsible for the implementation, configuration and maintenance of ISIS, thus allowing Credit Union staff more time to deal with customer issues (Mangan and Stahl, 2002). It was to improve the number of features, services offered by the Credit Unions i.e. ATM cards, debit cards, electronic fund transfers and financial services and integrate all software and hardware solutions throughout all the Credit Unions (O'Connor, 2000). This was indeed a positive vision by the Board of Directors of the ILCU. This would be a very complex solution considering there was no standard practice for software and hardware use within the Credit Union movement. It was believed that this would be too costly to implement such standards (Ironic). In July 1998, ILCUTECH hired OSI, a British financial consultancy company. They estimated the cost would be $40 million and this would include procurement of the systems and software, the setting up of the organisation and the running cost of ILCUTECH until 2003 (Mangan and Stahl, 2002). A business case review in October 1999 revealed that everything was on time and in budget. In January 2000, a project review revealed that the ISIS project would now cost £68 million and the project had falling behind on schedule due to the slow pace of the implementation stage. At the end of 2000, the ISIS project was abandoned (Mangan and Stahl, 2002).

The next stage of this investigation required the author to understand why the project estimate increased by £28 million and the implementation phase of the project fell behind time (Mangan and Stahl, 2002). It was identified that the Credit Union movement was suffering from a schizophrenic identity. A term used by the author to describe the current personalities of the Credit Union movement. The movement was at a crossroad; it had the ILCU proactive movement, which influenced the take up of the ISIS project. The larger, more corporate type Credit Union, who believed that the Credit Union should modernise and attain professionalism to survive, supported the ISIS project. The traditionalist within the Credit Union movement did not share this view. They believed the Credit Union should retain its traditional focus on mutual self-help, voluntary work and a not-for-profit ethos (Mangan and Stahl, 2002). It is widely accepted that when someone is faced with an uncertain future, they confront this problem with an inward, negative approach, which is shrouded with the need for security. This allows them to feel safe and secure within the boundaries of their community. The introduction of a centralised information system would most certainly have reduced the power, individuality and certainty to an individual within a Credit Union. By creating a centralised system the balance of power shifts from the individual Credit Union, thus losing their identity. This socio-technical problem exists right across the spectrum of industry, as the introduction of technology threatens an individual's identity and sense of purpose (Mangan and Stahl, 2002). This area is too large to examine within this paper, but it is important to identify that this problem does exist and is widespread across all industries. This conflict existed before the implementation of the ISIS project and it is believed this is what derailed the progress of the implementation process (Mangan and Stahl, 2002).

The other factor that caused the cancellation of the ISIS project was the lack of management within the progress of the project. In the space of three months the project was viewed as been on schedule and budget, to been £28 million over budget and over time. The lack of management over the consultants (OSI) and project developers (ILCUTECH) resulted in bringing the project to the state of failure (Mangan and Stahl, 2002). It was believed by ILCUTECH, that consultants would act in the best interests of the Credit Unions, where in fact, the consultants would act to improve their own self-interests. The lack of project management experience by the ILCU Board of Directors was heavily criticised and it was believed to be one of the main contributing factors to the failure of the ISIS project (www.businessost.ie).

3.4.3 Conclusion

The previous sub-section clearly outlines the two main reasons that contributed to the failure of the ISIS project. The lack of strong leadership, vested interests and the complex structure of the Credit Union movement all had a significant bearing on the collapse of the ISIS project. The table below is a summary of the major issues that contributed to the collapse of the ISIS project. The ISIS project was a level three failure and the large number of critical success factors that were lacking in this project should be evident in the graphical representation in figure 3.2.

- Complex Solution
- Growth of Scope
- Initial Estimates
- Implementation process
- Vested interests
- Consultants
- ILCUTECH Board of Directors
- Lack of Team Work
- Lack of User Involvement

Figure 3.1 Factors that contributed to the ISIS project failure – *Source: Author*

3.5 NATS (National Air Traffic Control Services)

The difficulty in examining why NATS Air Traffic Control System was years delayed and millions over budget is that there has been no public enquiry into the shortcomings of the project. This paper will examine previous literature on the NATS disaster and analyse this against the proposed critical success factors. The difference with this case study is that NATS is an essential service, thus allowing it to grow in cost and time. The total cost of developing NATS was £623 million and it was 6 years over the due date.

3.5.1 Background

The National Air Traffic Control Services (NATS) provides complete air traffic control service for the UK airspace. By the late 1980s the system in place was reaching its capacity and there was a need for a new system to control the skies of the UK (www.nats.com). In 1987, the Civil Aviation Authority (CAA) presented its case to the government for a new air traffic control centre and system. The management strategy for the project lasted one year (1989-90) and they estimated the project would have a lifetime of 8 years (Collins, 2002). This estimate was two years over the expected due date of 1996. In 1990, an independent consultant group (Mitre Corporation) was brought in to scope the project and they insisted in their report that the NATS project would take a minimum of 13 years. Their predicted operational date was 2003 (Collins, 2002). This is significant when you consider the final rollout of NATS was in 2002, but this still had a lot of bugs and problems. The project management team decided against the advice and continued with the initial date of 1996. This bravado attitude would ultimately bring a sting in the tail for the management team. Having failed to complete the definition phase in 1992, IBM move ahead with the implementation stage with a lot of the requirements still undefined. The requirements have been set by a small group of Air Traffic Controllers, who are not considered as representatives of them all. This brings tension to the project, as a lot of Air Traffic Controllers feel they are not been collaborated with during the project design and implementation phase (Collins, 2002). Denial of problems seems to transcend across all management within the project team. In 1994, Civil Aviation Authority (CAA) denies that there is a serious problem with the system. At the same time Loral acquire IBM's air traffic division and conducts a secret audit of the Swanwick system. Their findings concluded that there were 21,000 defects in 2 million lines of code (Collins, 2002).

3.5.2 Technical difficulties

The technical difficulties were evident throughout the life of the NATS project. Firstly, there were three different providers i.e. IBM (1992-94), Loral (1994-96) and Lockheed Martin (1996-2002). It was a complicated system that required the integration of many legacy systems (Collins, 2001). Like the failed Taurus project, running modern software solutions on 1970s legacy systems is hard and complicated to maintain. Another contributing factor that resulted in project failures was that the project team. The team were new to the area of air traffic control and did not understand the workings of an air traffic control system (Donaldson and Erskine, 2002). The project teams (IBM and Loral) could not deliver the projects functionality. Lockheed Martin found 15 errors per 1,000 lines of code, which seemed a poor base of quality. NATS been such an essential Air

Traffic Control system, errors like this could have catastrophic consequences. The Lockheed Martin packages worked well initially on 30 workstations, but scaling it to 150 workstations was too much for the system that possessed too many bugs. The project still went live in January 2002 and on the 18th of May the system crashed causing flight delays and cancellations (Donaldson and Erskine, 2002). The table below identifies a number of problems with the NATS project.

- Poor monitoring & control of plans & risks
- Technical problems
- Poor QA
- Inadequate development environment
- Requirements not understood
- Poor team collaboration & communication
- Scope creep

Figure 3.1: NATS project problems *– DSDM Consortium 2002*

3.6 An analysis of IS project case studies

The analysis procedure aims to integrate the reasons for project success and failure in section two with the conclusions drawn from each case study examined in section three. The table below identifies the critical success factors that were present in the life of the ITS projects that were examined in the previous sub-sections i.e. Taurus, DIA, ISIS and NATS. The tick indicates the project that was examined had that critical success factor present within the life of the project. The 'x' indicates the critical success factor was not present in the life of the project. This clearly demonstrates the shortcomings that existed in the project's life. It is clear from the table that most projects lacked the necessary factors that could have made them a success, thus resulting in minor, major or critical failures.

Critical Success Factors	***TAURUS (1993)***	***DIA (1995)***	***ISIS (2000)***	***NATS (2002)***
User Involvement	√	√	X	X
Executive Management Support	√	√	X	√
Clear Statement of Requirements	X	X	X	√
Proper Planning i.e. cost and time estimate.	X	X	X	X
Realistic Expectations	X	X	X	X
Smaller Project Milestones	X	X	X	X
Competent Staff	√	√	X	√
Ownership	√	√	√	√
Clear vision & Objectives	X	√	X	√
Hard-Working, Focused Staff	√	√	√	√
Project delivers its functionality.	X	√	X	√
Delivered to budget, on schedule, and to technical specification.	X	X	X	X
Commercially profitable for the contractor.	X	√	X	√
It satisfies the needs of the owners, users, project team and stakeholders.	X	X	X	√
Project achieves its purpose and objectives.	X	√	X	√
Leadership and Management	X	X	X	X
Communication and teamwork	√	X	X	X
Adequate Resources and Funding	√	√	X	√
Minimum start-up difficulties	X	X	X	X
Absence of bureaucracy and politics	X	X	X	X

Figure 3.1: Critical success factors present in ITS case studies – *Source: Author*

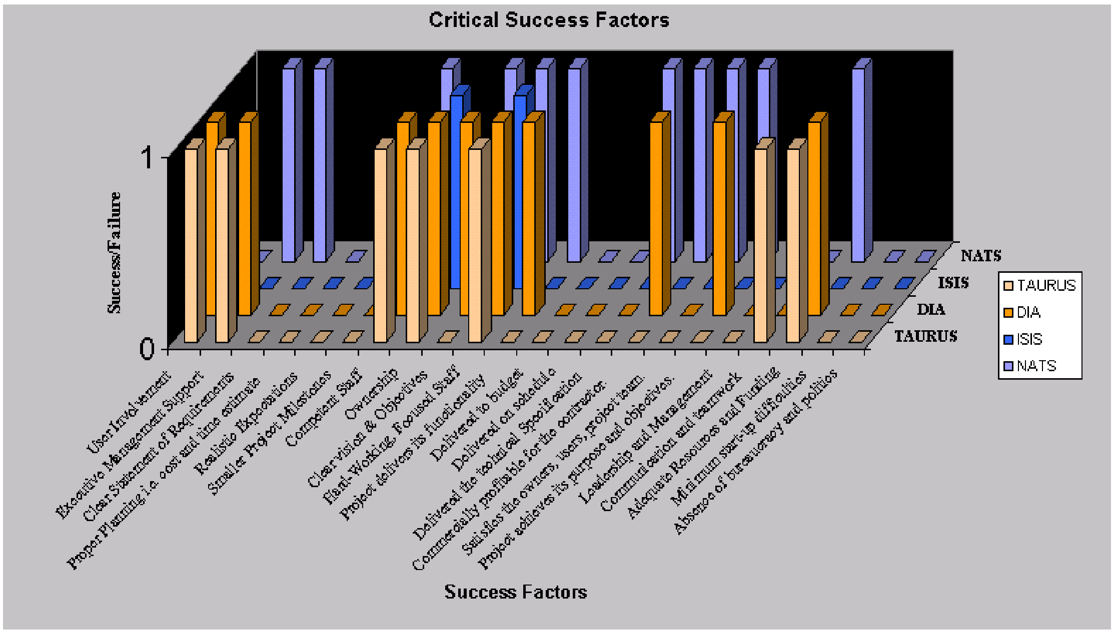

Figure 3.2: Critical success factors present in ITS case studies – *Source: Author*

Observing the twenty CSFs that were presented by the author in figure 3.1. The two case studies that had critical failure (defined in Fig 2.1) had very few CSFs present in the life of the project. The Taurus project had seven CSFs present and the ISIS had two CSFs present. This is an alarmingly low number of CSFs and if the project management team had created adequate risk analysis of the project prior and during the life of the project, they could had averted or stopped the project from escalating into failure. The projects that suffered major failure (defined in figure 2.1), but eventually got finished, also had a number of CSFs missing during the projects life. The DIA automated baggage handling system had ten CSFs present according to the author's findings. It had 50% of the factors, thus succeeding after major disruptions. The NATS project also had eleven CSFs present in the author's findings. It was also an essential service to the UK, so failure was not a possibility. The graph below represents the CSFs graphically for the different case studies examined in this paper. A score of one was given if a CSF was present. If there was not a CSF present a score of zero was given. Along the horizontal axis are the CSFs, the vertical represents the score given and the 3-D axis presents the different case studies. It is apparent from this 3-D chart that the projects that possessed the greater number of factor, were most likely to succeed.

3.7 Summary

This section investigated four large-scale ITS investments. The CSFs that were identified in section two were used to examine the successes or failures of each individual case study. This enabled the author to draw conclusions on the reasons why IS projects have such a high rate of failure. The author proposes a system that can be used by researchers and developers to investigate if ITS projects are following a path to success. This can reduce the amount of investment wasted on projects that might not have a good business case, or incorrect business structure and processes that will reduce an organisations ability to harness the advantages that could be brought about by such an investment. Figure 3.2 graphically illustrates the factors that were present or not in the cased studies that were examined. It is evident from this graph that the projects that failed possessed very few CSFs and the projects that succeeded had possessed a number of CSFs.

4 Conclusion

Although there has been an immense amount of research completed in the area of IS project failure, most research fails to link and integrate different areas of failure. This paper has analysed the reasons for failure and has proposed a framework of critical success factors that are deemed crucial for IS project success. This work is complimented by the analysis of individual case studies. Although a lot of work has been done in improving IS development and processes, there is still a major gap in the re-engineering processes that enable an organisation to harness the advantages of integrating their business processes using an intelligent information system. There is need for a technical and business expert in the development of an IS system.

The author has identified a number of issues that could be investigated further. The issue of risk management techniques used in project development could be examined to compliment the CSFs model. Another important area that could be examined further is social constructivism and how it influences the outcome of an IS project. This idea is understood to mean that while the mind constructs reality in its relationships to the world, this mental process is significantly informed by influences from social relationships' (Mangan and Stahl, 2002). This idea has influenced the outcomes of all the case studies examined in section three. The author has not examined this in great detail; as to do so would merit a paper in itself. This could be combined with the research completed in this paper to further understand the external influences that contribute to a project's success or failure.

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Appendix 1 – Acronyms

CSFs
- Critical Success Factors

DCVs
- Destination Coded Vehicles

DIA
- Denver International Airport

DIABHS
- Denver International Airport Baggage Handling System

ILCU
- Irish League of Credit Unions

IS
- Information System

ISIS
- ILCUTECH Standardised Information System

IT
- Information Technology

ITS
- Information Technology System

NATS
- National Air Transport Service

UA
- United Airway's