3-31-2009

Factors Affecting The Level Of Success Of Warehouse Management Systems

Susanna Patton

Logistics Manager Karndean International, Evesham, UK, susanna.patton@karndean.co.uk

Crispin Coombs

Business School, Loughborough University, UK, c.r.coombs@lboro.ac.uk

Follow this and additional works at: http://aisel.aisnet.org/ukais2009

FACTORS AFFECTING THE LEVEL OF SUCCESS OF WAREHOUSE MANAGEMENT SYSTEMS

Susanna Patton*, Crispin Coombs**
*Logistics Manager Karndean International, Evesham, UK
Email: susanna.patton@karndean.co.uk
**Lecturer in Information Systems, Business School, Loughborough University, UK
Email: c.r.coombs@lboro.ac.uk

Abstract

In recent years the sophistication and application of Warehouse Management Systems (WMS) has increased significantly and they are now seen as vital systems for gaining efficiency improvements and cost savings within the logistics industry. However, the successful implementation of a WMS is rare. Therefore, this study's aims were to explore the key factors that influence the success of a WMS development project. Twenty two interviews were conducted with Directors, Senior Managers and Consultants that had been associated with WMS implementations. The findings show that there are conflicting views between Directors and Senior Managers with both groups focusing on different priorities during a WMS project. In addition, appointment of a project champion, frequently an external consultant is important in ensuring that there is good communication between all the stakeholder groups. The study concludes that many Directors need to develop their understanding of WMS development projects, in order to avoid becoming completely reliant on a consultant project champion who is always likely to leave the organisation at some point.

Keywords: Warehouse Management Systems, Success, Qualitative.

Topic Areas:

* IS Development and Project Management

* IS Evaluation and Benefits Management

FACTORS AFFECTING THE LEVEL OF SUCCESS OF WAREHOUSE MANAGEMENT SYSTEMS

Abstract

In recent years the sophistication and application of Warehouse Management Systems (WMS) has increased significantly and they are now seen as vital systems for gaining efficiency improvements and cost savings within the logistics industry. However, the successful implementation of a WMS is rare. Therefore, this study's aims were to explore the key factors that influence the success of a WMS development project. Twenty two interviews were conducted with Directors, Senior Managers and Consultants that had been associated with WMS implementations. The findings show that there are conflicting views between Directors and Senior Managers with both groups focusing on different priorities during a WMS project. In addition, appointment of a project champion, frequently an external consultant is important in ensuring that there is good communication between all the stakeholder groups. The study concludes that many Directors need to develop their understanding of WMS development projects, in order to avoid becoming completely reliant on a consultant project champion who is always likely to leave the organisation at some point.

1   Introduction

The last decade has seen leaps in the sophistication and application of warehouse management systems (WMS). Logistics and supply chain providers recognise the business benefits of such systems which drive operational efficiency and process, in an effort to outperform competitors in terms of customer service, lead times and cost (De Koster, 1998). In an industry marked by high capital expenditure, stringent cost control, and warehouses which typically account for 5 – 8 % of costs (CILT 2008), it is the implementation of such systems which provide the "value added" for an organisation. However, the successful implementation of a warehouse management system is rare. For example, Only 17 of companies that installed warehouse management systems regarded their projects as "highly successful" according to a report from the Warehouse Education and Research Council (WERC, 1999). Consequently, the overall aim of this study was to explore the key factors that influenced the success of a WMS implementation.

The structure of this paper is: firstly, a brief overview of the relevant information systems literature and a statement of the research objectives for this project; secondly, a description of the methods by which the research was conducted; thirdly the research findings are presented; fourthly the results are discussed; and finally, their importance is assessed in the concluding section.

2   Contextual Background and Research Objectives

In the past twenty years much interest has been generated in the identification of factors critical to the successful outcome of systems development projects. A range of empirical and in-depth studies have been conducted which examine success factors in the development and implementation of information systems (For example: Flowers, 1997; Li, 1997). These, and other studies, have helped to focus IT professionals' attention on the importance of factors such as: user involvement (Whyte and Bytheway, 1996); senior management commitment (Sauer, 1993); Staff training (Whyte and Bytheway, 1996) and systems testing (Ennals, 1995). Whilst all these studies have helped to develop a formidable body of knowledge with regard to 'best practice' in systems development, little research has been conducted into the application of best practice, in WMS projects.

A further important strand of research concerns the organisational impact of information systems. It has been recognised that the level of penetration and sophistication of information technology is growing rapidly, and with this expansion goes a concomitant increase in the level of the organisational impact of information technology. For example, it has been found that the implementation of information systems can precipitate changes in: organisational structure (Stebbins et al., 1995); organisational culture (Butterfield and Pendegraft, 1996); working practices (Hornby et al., 1992) and the distribution of power (Thach and Woodman, 1994). To date, little empirical work has been conducted to explore this relationship, in relation to WMS implementation.

WMS's are used by organisations to increase the productivity and efficiency of their warehouses, and the logistics sector has employed WMS as a business tool for approximately twenty years. In its simplest form a WMS monitors the goods-in, put-

away, rotation, pick and despatch of all stock units held within a warehouse. The management information provided by the WMS allows an organisation to manage the stock levels and orders appropriately, and to service customer requirements as efficiently and effectively as possible utilising existing labour capital. Information is typically captured using barcodes or digital imaging with the data relayed to the main server(s) providing near real-time information. The WMS allows a stock item to be tracked throughout the warehouse, identifying its precise location at any given time.

In the 1990s the majority of WMS's were tailor made (Randall, 1999) and many early implementations of WMS's were primarily designed as a simple aid to warehouse management Webb (2002). However, in the last ten years increasing levels of investment in systems development has led to a proliferation of more sophisticated WMS packages from a variety of suppliers (Nynke Faber et al, 2002). Indeed, Johnson (2007) and Edwards (2007) both note that in the last two years alone the industry has seen the introduction of second generation voice technology, and further efficiencies in RFID. As WMS's become more integrated into organisations so it is likely that they will have a greater impact on the culture, processes and working practices of an organisation, driving structural change and often a subtle shift in the balance of organisational power.

For example, anecdotal industry evidence suggests that the increasing reliance on WMS's has a corresponding impact on the need to address organisational issues, such as the communication and management of expectation between various levels of the organisation. Frequently, those who procure the system have never worked within a warehouse and are limited in their knowledge during the selection process prior to purchase. In contrast, the end-users commonly cannot express their precise requirements as they are highly accustomed to the existing system or process and seek to replicate it. The lack of understanding between these two stakeholder groups may well explain some of the difficulties associated with WMS implementation. Recognition of this phenomenon is further supported by the establishment of an industry-wide committee in 2007, the WMS Forum, to assess the industry and organisational impacts of WMS implementation, and to research methods of best practice.

To address these issues a research project was initiated, to explore the issues associated with implementing a WMS and to explore how perceptions differed between three of the main stakeholder groups, namely Directors, Senior Managers and Consultants. This approach ensured that the following research objectives could be addressed:

1. To identify the key elements of best practice required for a successful WMS implementation;
2. To compare and contrast the differing perspectives held by Directors, Senior Managers and Consultants regarding the implementation of a WMS; and
3. To explore how these differing views may impact on the eventual success or failure of a WMS development project.

It was envisaged through the exploration of these issues it would be possible to provide advice to the Logistics industry in general, with regard to the successful development and implementation of warehouse management systems.

3   Method

During March - April 2008 twenty two semi-structured interviews were conducted with Directors, Senior Managers and Consultants within the logistics industry, all of whom had been significantly involved with a WMS implementation at different organisations. Respondents were selected on the basis of their prior experience and involvement with WMS implementation at a senior level. For example, a Director normally managed multiple sites; a Senior Manager would be a functional head, (for example, a logistics manager or supply chain manager) and a Consultant would be ex-operational at a senior management level. All participants and their organisations were guaranteed anonymity due to the sensitivity of the questions and potential answers.

In total the 22 interviewees could be further sub-divided into 6 directors, 8 senior managers and 8 consultants. All organisations which were represented had a minimum £100m turnover per annum and were dispersed across a range of sectors

and sub-sectors, ranging from multi-national organisations to SME's and from 3PL to FMCG and manufacturing logistics.

A series of background questions were asked to provide a demographic breakdown and frame of reference for the author. The semi structured interviews comprised eight open questions intended to allow the interviewee the opportunity to provide evidence within context:

1. Describe your organisation.
2. Can you tell me story about a great WMS implementation success?
3. What aspect of your organisation is important to the board/ senior managers?
4. What are the criteria for progression or dismissal in your organisation?
5. Can you tell me a story about a dramatic WMS implementation failure?
6. What are your organisations' strategic goals and objectives?
7. How frequently do crises arise in your organisation / function and how are they dealt with?
8. How would you improve your organisation?

The responses to the interviews were transcribed and were mapped to a matrix, allowing a categorisation of common themes which were identified from the data. Five broad themes emerged from the interviews: Senior Management Commitment and Participation; Perceptions on WMS success; User Involvement; Technical Specification and Testing; and The Role of the Project Champion. The following section considers each of these themes in turn.

4 Findings

4.1 Senior Management Commitment and Participation

Both Directors and Senior Managers felt that senior management commitment and participation was important. However, the emphasis was subtly different between groups. Directors tended to view the investment in WMS from a more removed position, suggesting that it was a useful public relations tool, and that the main function of the WMS should be to deliver improved service across the organisation as a whole.

By contrast, Senior Managers viewed implementations from a more operational perspective with some being extremely keen to be involved at a "hands-on" level. However, some senior managers also noted that in their experience there were occasions when the board merely paid lip-service to supporting the implementation.

The Consultants offered a more holistic view of senior management participation and appeared to be even more aware of the varying levels of actual participation from board level Directors. Comments included:

> "…realistically speaking the board is only interested in top and bottom line. It is left to operations to deliver" (C5).

> "…I've heard some Directors comment that they're not interested in how it gets done – that's what they pay the managers for". (C6)

Overall the issue which seems to emerge is that whilst all interviewees reported that they considered senior management commitment and support to be integral to success, the reality is that often little practical support is actually given. In practice it would appear that a WMS implementation is often viewed as an organisational investment which is used as a publicity tool by Directors with few willing to engage with the complexity of the actual challenges of implementation.

4.2 Perspectives on WMS 'Success'

Two clear issues emerged under this theme – costs and return on investment, and success in terms of service benefits. Every Director identified that cost benefit was a fundamental requirement, closely followed by service benefits to the organisation and some form of "value added".

> "…like any investment it must undergo full cost benefit analysis and deliver demonstrable return". (D2)

> "…the system must deliver both cost and service benefits, with minimal negative impact across the business during integration" (D6).

It is clear from this evidence that the Directors are strongly cost driven with five out of the six Directors interviewed citing cost as a major driver. By comparison, Senior Managers were more service focused when thinking about how successful a WMS had been. However, the difficulty of being able to clearly identify the benefits and thereby determine whether a project had been successful were acknowledged. For example, a senior manager commented:

> "…the level of labour resource required up-front to implement change makes it difficult to isolate and identify the benefits" (SM5)

Similarly, a Consultant commented that one organisation had devoted so much resource to ensure that service levels were maintained that problems were hidden until this resource was cut back.

> "…it was easy for them to achieve service with so much resource, but it masked gross labour inefficiency which become apparent after sharp budget cuts were required" (C3)

When considering the views of Consultants it is clear that they can see both the pros and cons of each perspective. As a group they appreciate that decisions at Director-level are frequently cost driven. However they also understand that a pure service level success measure is equally distorting.

> "…I have been into several organisations where voiced driver was service, but the true driver was cost. It becomes even more apparent as the managers manipulate their budgets so that the costs sit in the right column" (C2)

The difficulty with such an approach by an organisation is that energy is expended in managing and manipulating budgets, which is energy that could be more effectively utilised elsewhere. It is also clear that there appears to be a lack of clarity in some WMS development projects as to what is actually driving the project (e.g. reducing cost or improving service quality) and therefore how its success should be measured.

4.3   User Involvement

When considering User Involvement, it became apparent that Directors were considerably removed from the operational element of their organisations. Comments were couched in terms of speed of implementation, for example:

> "…speed of training is a key factor; it must enable us to have a labour resource which we can flex up and down in line with demand". (D2),

> and "…the system must deliver rapid on-the-job training to deliver maximum utility". (D5)

Analysis of these comments supports the view that Directors are cost-focussed, with their comments emphasising the importance of the bottom line when talking about resource and speed of return on investment. What is also interesting is that they do not appear to be considering the users as individuals, but as a resource to be utilised to maximum effect. By comparison, Senior Managers appear to adopt a more people orientated view, understanding the potential impact of operational change and staff unrest on the eventual success of the WMS.

> "…the power of the Unions should never be underestimated; a work-to-rule destroys an operation which is why it's vital to have them [the Unions] on side". (SM1)

> and "…it's extremely important to get the shop-floor on 'on-board' so that they approach the change with the right attitude". (SM5)

Other Senior Managers note the general dislike of operational change unless it is "sold" to the workforce, with five of the eight Senior Managers giving voice to their concerns over the need to include the shop floor employees from the outset.

> "…you would be surprised how much effort they [the employees] will spend trying to get the new system to do what the old one did; it takes time to adjust." (SM6)

The clear theme emerging from the comments of the Senior Managers is that of reluctance by employees to embrace the organisational and process change associated with a WMS implementation. This view of the importance of presenting change in a

positive way is strongly supported by the Consultants, all of whom reported that they would try and identify and use a key stakeholder to help deliver change.

> "…the most effect method of implementation I have ever found is to get the key players on the [shop] floor involved from day one; get them on page and that's three quarters of the battle". (C2)

Consultants seem to support this method because they recognise that across a multi-site operation each site will have a slightly different approach, which must be refined at each stage of a WMS implementation roll-out.

> "…when I first approach a project like this I like to have operational people involved in the planning stages. They know the idiosyncrasies … which must be taken into account" (C6)

The data suggests that user involvement is important to the success or failure of a WMS implementation. In particular, identifying and involving key stakeholders in the early stages of WMS implementation is pivotal in ensuring that organisational knowledge is utilised to plan and manage the change engendered by implementing the WMS.

4.4   Technical Specification and Testing

The views on technical specification and testing were markedly different between the Directors and the Senior Managers, whereas the Consultants were able to appreciate the perspectives of both groups. The primary concern of the Directors was the smooth implementation of the WMS and integration with existing software tools and information systems to maintain and protect current service levels. They were also particularly concerned that reduced customer service levels caused by the WMS implementation could have an immediate financial cost with wider negative impacts on the organisation's reputation. Comments from the Directors included:

> "...the WMS must be compatible with both our own software and that of our clients. Failed data transfers are costly!" (D6)

> "...my main concern is that service is not affected, and the organisation is left exposed. It [the WMS] must deliver the benefits it promises". (D1)

It is interesting to note that the Directors did not comment on the actual method of implementation, whereas the Senior Managers felt this was the main area of concern. Their focus was very much on the effect that the implementation would have if there was any difficulty with the integration, which was reflected in specific references to avoid tailoring the WMS.

> "...match your warehouse to your system, not your system to your warehouse". (SM5)

> "...you may as well keep it [the WMS] as simple as possible. You won't use three quarters of it [the management information] anyway." (SM6)

By contrast, the Consultants adopted a more holistic approach and appreciated the views of both the Directors and the Senior Managers. Their most common observation was that miscommunication between the software house and the organisation led to an over-complication of the WMS requirements, and that often the host organisation had difficulty in clearly specifying the requirements for the WMS.

> "...in my experience communication breakdown results in over-specified systems, often as a result of the organisation not knowing how to define their requirements in the first instance". (C1)

Consultants also discussed the benefits of modular packages both for ease of integration and for the overall business requirement to maintain service during implementation. They were of the opinion that it was preferable to invest time in the initial planning stage to ensure that there was a clear understanding of requirements between the software provider and the organisation, and that thorough testing had taken place prior to go-live. It was also noted that a further benefit of modular implementation was the ability to upgrade with minimal disruption as technology develops.

> "...with the continual technological upgrades a WMS has a shelf-life of 10 years or so, so a modular option is usually far more cost-effective" (C8)

Overall, Consultants were cognisant of the opinions of both the Directors and Senior Managers, appreciating both cost and operational requirements throughout the implementation and the associated process changes which would accompany this.

4.5   The Role of the Project Champion

Again there were marked differences of opinion between the groups when they were considering the role of the project champion. The Directors were unanimous in their view that an external specialist should be brought in to manage the project and that there was a cost associated with this.

> "...we should pay to enlist a professional logistician". (D4)

> "... [it] makes good business sense to implement using a specialist ... the system is an investment intended to deliver value-added" (D6)

From the data there was a clear message that the Directors believed that investment in specialist knowledge was a worthwhile one. However the responses from the Senior Managers were more mixed. Some concurred with the opinion of the Directors that it was beneficial to invest in external skills "...you need an experienced consultant involved from the outset" (SM8), whereas other Senior Managers argued that, "... [The Project Champion] must be someone with genuine power and respect within the organisation" (SM1). Overall, the majority of respondents agreed with the former view with 19 of the 22 respondents saying that they believed an external champion was preferable. However, there was an underlying message that organisational issues such as process and culture must be managed effectively during the implementation and that the credibility of the Project Champion was a key attribute in addressing these issues. These threads were also identified by the Consultants who focussed strongly on organisational issues and the need for the Project Champion to have credibility.

> "…employ someone with experience of people and change management. It is easy to deliver the hardware; the skill is in getting people to accept it" (SM7)

The Consultants considered skill set of the individual to be pivotal in the success and a particularly strong theme was that of effective communication.

> "...an ability to communicate...and generate positive responses to [organisational] change is far more important". (C2)

Consultants were also vocal on the point that the Project Champion was generally more effective if they were a strong and operationally experienced leader.

> "...a strong and experienced operational manager is a vital component in the implementation". (C4)

Moreover the Consultants agreed with the Senior Managers that one of the most significant challenges facing the Project Champion was their credibility and the level of respect they had within the organisation. The Consultants preferred an experienced external champion over an internal champion due to the operational experience required to manage people through change, although their caveat was always that the Project Champion should have the respect of the shop floor. Overall, the ability of the Project Champion to lead the operation through process and cultural changes was considered to be more significant than any specific IS skill set.

Certainly there was strong evidence from the interviews to suggest that the role of the project champion had a direct link to the success of the WMS project. For example, one respondent when discussing a project that achieved both budget and service improvements during and post implementation attributed the success of implementation to the project management skills of the project champion, who was deemed to have managed the project end-to-end.

> "…the investment in a specialist consultancy was worthwhile; the skills and knowledge of the project team were invaluable during the implementation" (D5)

Similarly, another Senior Manager commented on the importance of having a good project manager in the role of project champion stating that,

> "… the fact that we had an employee with the relevant skill set as the project champion was instrumental in the success of the project" (SM2)

Conversely, comments from one Director illustrate the risks of not getting a project champion in place to lead the project. They stated,

> "…the decision was on a cost basis. Consensus was not to pay for the necessary expertise to implement … [in retrospect] it was the wrong decision" (D3)

It is clear that the majority of interviewees placed a high degree of importance on the appointment of a good project champion with sufficient skills and technical expertise to be able to lead and manage the project effectively. The importance of this person having credibility throughout the organisation also appears vital in order to be able to convince the board of the benefits of the WMS while simultaneously encouraging "self-ownership" of the implementation project by the shop floor employees. This requires a thorough understanding of the WMS and the actual requirements of the organisation, (as opposed to what they think they want), and the ability to align the capabilities of the WMS with organisational requests.

5   Discussion

The findings suggest that there are quite different perspectives regarding a WMS implementation from the three stakeholder groups interviewed. There is a strong priority associated with reducing costs as a result of implementing the WMS from Directors. The Directors also seem to acknowledge that if service levels fall as a result of the implementation then these will also have a financial cost to the organisation. However, it also appears that many of the Directors interviewed seem to be less aware of the wider implications of implementing a new systems development project within an organisation, the complexity of this task and the wide ranging possible organisational impacts that may also be caused.

Senior Managers are more aware of the service issues associated with implementing a WMS and this is probably due to their position as they are likely to have the complaints from both the users and the Directors if the system fails to perform as required. Consequently, it is likely that the Senior Managers have a stronger vested interest and awareness of the importance of managing the change process effectively as it is they who would bear the brunt of the problems if things go wrong. However, this role is likely to be made more challenging because of the lack of support and understanding that seems evident among many Directors associated with WMS projects.

However, although the Directors seem to lack a sufficient awareness of systems development project issues, there also appears to be a general lack of IT and IS knowledge within the organisations studied. This lack of knowledge seems particularly apparent because of the frequent problems in terms of developing an accurate requirements specification for the WMS, which ultimately leads to further conflict between the software supplier and the user organisation. In many cases it appears that either the organisations have relatively few IT staff, or the IT staff do not have sufficient expertise in WMS. Those organisations that recognise this deficiency seem to make a conscious effort to bring in external consultants with relevant expertise. It is somewhat ironic that the vast majority of Senior Managers and particularly the Directors recognised that employing consultants was important to overcome this knowledge gap, despite the associated cost with their employment. It suggests that while Directors can tolerate this cost, they see it as a necessary addition to increase the likelihood of a successful WMS implementation. What they do not appear to appreciate is that it is their own lack of understanding of the WMS and its impacts is a key problem and that they need to further engage with the implementation process. Simply buying in a consultant may help, but this in itself is unlikely to be sufficient to get long term benefits from the system, as the consultant is only present for a relatively short period of time and has limited motivation for sharing large amounts of information, due to the need to encourage repeat business.

What also seems apparent from the findings is that the role of the project champion can be crucial in determining how successful a WMS project is, whether this person is a bought in consultant or internal member of staff with sufficient technical knowledge. The project champion appears to be acting as the key channel of communication between the Directors, Senior Managers and Users and thereby ensuring that these different groups are co-ordinated and have a better understanding of the different views of other groups. One could argue that the project champion acts as the glue to hold a WMS implementation project together and it would appear that the more successful WMS implementations did have a good project champion in place. However, placing such reliance on one individual is inherently risky, especially if that person is an external consultant, which seems to be the preferred route, as the organisation may well lose this clarity of understanding and communication once the project champion moves on to a new client.

6   Conclusions

This study has identified some important findings for successful WMS projects. It is apparent that a lack of understanding among senior managers regarding WMS development projects is likely to be a significant problem in ensuring senior management commitment to the project which has been regularly identified in the IS literature as a key element of best practice. At the moment, this weakness is being addressed to some degree through the use of external consultants often in the role of a project champion. However, the Directors need to recognise that in order to get the best from this approach; the consultants need to be involved throughout the development project, from requirements specification, through implementation to the actual operation of the system. However, there is also a need to accept that in order for the WMS to make a long term positive contribution to an organisation it is important for Directors to have a better understanding of the use of a WMS and the wider impacts these systems can have on an organisation.

7   References

Butterfield, J. and Pendegraft, N. (1996) Cultural Analysis in IS Planning and Management, *Journal of Systems Management*, 47(2):14-18.

CILT (2008) *Annual report on industry performance*, Chartered Institute of Logistics and Transport, Corby.

De Koster, M.B.M. (1998) *Recent developments in warehousing*, Working Paper, Rotterdam School of Management, Erasmus University, Rotterdam.

Edwards, G (2007) Time to Integrate the fleet? *Logistics Manager* (Dec 2007) available online at http://www.logisticsmanager.com/Articles/8165/Time+to+integrate++the+fleet.html, accessed 15 Feb 2009.

Ennals, R. (1995) *Preventing Information Technology Disasters*, Springer, London.

Flowers, S. (1997) Towards predicting information systems failure, In Avison, D. (Ed.) *Key Issues in Information Systems,* McGraw-Hill, Maidenhead, 215-228.

Hornby, C., Clegg, C., Robson, J., McClaren, C., Richardson, S. & O'Brien, P., (1992) Human & Organisational Issues in Information Systems Development, *Behaviour & Information Technology,* 11(3): 160-174.

Johnson, L (2007) UK Lags in Supply Chain IT Integration, *Logistics Manager* (Jan 2007) available online at http://www.logisticsmanager.com/Articles/7814/UK+lags+in+supply+chain+IT+integration.html, accessed 15 Feb 2009.

Li, E. Y. (1997) Perceived importance of information systems success factors: A meta analysis of group differences, *Information & Management,* 32(1): 15-28.

Nynke Faber, R. De Koster, BM and Van de Velde, S.L. (2002) Linking warehouse complexity to warehouse planning and control structure, *International Journal of Physical Distribution and Logistics Management*, 32 (5): 381-395.

Randall, S. (1999) The value of WMS, *Transportation and Distribution*, 40 (2): 63-6.

Sauer, C. (1993) *Why Information Systems Fail: A Case Study Approach*. Alfred Waller, Henley.

Stebbins, M., Sena, J. & Shani, A. (1995) Information Technology and Organisation Design, *Journal of Information Technology*, 10: 101-113.

Thach, E and Woodman, R (1994) Organisational change and information technology: Managing on the edge of cyber space, *Organisational Dynamics,* 23: 30-45.

Webb, K (2002), Wearable Computer Boosts Confidence, Logis*tics and Transport Focus*, (June 2002) available online at http://logisticsmanager.madgex.co.uk/Articles/7740/Wearable+computer+boosts+confidence.html accessed 15 Feb 2009.

WERC (1999) *Warehouse Systems and the Supply Chain: A Survey of Success Factors*, Warehousing Education & Research Council, Oak Brook, IL.

Whyte, G. and Bytheway, A. (1996) Factors affecting information systems' success, *International Journal of Service Industry Management,* 7(1): 74-93.