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An Investigation of the Factors Affecting the Adoption of E- commerce amongst UK-based Retailers

*by Neil Doherty, Fiona
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An Investigation of the Factors Affecting the Adoption of E-commerce amongst UK-based Retailers

NEIL DOHERTY, FIONA ELLIS-CHADWICK & CATHY HART

Key Words: The Internet; Retail Marketing; Retail Sector, United Kingdom.

***Abstract:** A multitude of opinions has been propounded to explain how the Internet can be exploited by commercial organisations. For the most part they are speculative, visionary or promotional. This work seeks to redress the balance by reporting on an empirical research project that has recently been conducted into the adoption of the Internet within the UK retail sector. More specifically, the research presented in this paper reports on the application of multi-variate statistical techniques to a large set of questionnaire responses, with a view to critically evaluating the factors that affect the adoption of the Internet. It has been shown that certain factors are far more significant than others, in influencing the adoption decision. In particular, it has been demonstrated that operating in an appropriate market sector and having a positive view of the viability of the Internet are of particular significance. Furthermore, the importance of developing a coherent and integrated Internet strategy, the need for senior management commitment, and the presence of an appropriate infrastructure and development capability are also highlighted. In conclusion, the paper summarises the implications of these findings for the development of retail strategy.*

1. Introduction

From its humble beginnings as a communications tool for use by scientists and academics, the Internet has grown exponentially in terms of both size and usage. Whilst, the growth of the Internet has already impacted upon most sectors of the economy, for example defence, banking, manufacturing, healthcare and education, it is amongst retailers that the most significant impact of the Internet is likely to be experienced. The Internet can be harnessed by retailers for the provision of information, the facilitation of two-way communication with customers, the collection of market research data, the promotion of goods and services and ultimately the on-line ordering of merchandise. In particular, this new communications medium offers the opportunity for retailers to expand into global markets, or to enter completely new market segments. According to Pyle (1996), the Internet's *'global connectivity opens up new avenues for business in a manner that traditional commerce conduits cannot match'*.

Since business organisations first started to experiment with the Internet for commercial applications, speculation has been rife about its potential as a new marketing medium. Field (1996) reported global Internet commerce to be worth \$518 million in 1996 and forecasted it to reach \$6.6 billion by 2000. In the United Kingdom, estimates about the rate and extent of its adoption have varied greatly. At the optimistic end of the spectrum, Pavitt (1997) suggests that *'by the year 2005 it will capture between 8 and 30 per cent of the UK retail market'*. By contrast other commentators have been more cautious: *'it will be 30 years before 30% of consumer activity takes place online'*. (Economist 1997). Despite the optimistic tone of some of these predictions, there is little evidence to suggest that many UK-based retailers have unreservedly embraced the Internet. Indeed, a recent study by Doherty et al (1999) concluded that only 10% of the UK's retailers had established a web-site, and only 3% had commenced on-line trading. Given the dynamic nature of the UK's retail sector and its normal inclination to be technologically innovative, it is unclear why so few retailers have adopted this new channel, and what factors have influenced their decision.

The research presented in this paper reports on the application of multi-variate statistical techniques to a large set of questionnaire responses, with a view to critically evaluating the factors that affect the adoption of the Internet. The following section of this paper discusses the adoption of Internet, as it is portrayed in the literature, before establishing the research objectives for this project. The development, validation, targeting and distribution of a postal questionnaire survey are described in section three. The research results are presented in a series of tables that are discussed in the fourth section, and their importance, and strategic implications for the retail sector, is assessed in the concluding sections.

2 Factors Affecting the Adoption of the Internet: Current Perspectives and Research Objectives

This section seeks to review the work of previous authors who have conducted studies of the factors likely to influence Internet adoption, and in so doing, define the research objectives that guided the execution of this research study. Teo *et al.* (1997) examined factors affecting Internet adoption amongst large business, based in Singapore, using a contingency model. The work concluded *"that organisational and technological factors were more important than environmental factors in the adoption of the Internet"*. In particular, aggressive technology policy, compatibility of the Internet with

organisational culture and infrastructure, and top management support were the most significant contingency factors affecting Internet adoption. Relative advantage was also considered to be important but to a lesser extent. However, the authors suggest these findings could be affected by the country's size and interventionist government policies supporting IT adoption and thus, some interesting results might emerge by researching an area where the role of the private sector was paramount.

Vadapalli and Ramamurthy, (1997) explored underlying motivations of business adoption of the Internet based on their study of large US-based, communications companies. They found some support for their proposition that organisational boundaries, transaction costs, economics and organisational cognition were determinants of business adoption of the Internet. In addition, they suggest the inherent self-fulfilling characteristics of the Internet affect levels of use: the greater the benefits the greater the level of use of the Internet. Furthermore, adopters need to perceive the potential value of the technology positively before they will adopt. O'Keefe *et al*, (1998) examined small business adopters (mainly retailers) of the Internet seeking to identify factors which, affect successful performance of Web-sites. They conclude that: the opportunity to expand markets could be affected by the *fit* between product and Internet demographics, perceptions related to the cost of doing business on-line (e.g. low cost and low risk) and consumer concerns (i.e. security, credit risks). These determinants affecting whether a business would realise the opportunities offered by the Web. However, product type and company size were not seen as differentiating characteristics of companies likely to perform well on the Internet but the extent of inter-activeness of their Web offer appeared to affect the overall success.

The recently published works of Teo *et al* (1997); Vadapalli & Ramamurthy (1997) and O'Keefe (1998), each of which targets a different organisational sector, provide evidence to suggest that there are a number of different factors affecting Internet adoption. However, there appears to be little agreement between these three pieces of work, as to what these critical factors are, which might suggest that such factors are sector-specific. Consequently, it is important that further work is conducted in additional sectors to determine whether such factors are completely sector-specific, or whether some patterns of commonality can be detected. In order to explore this issue further, a research study was initiated that sought to explore the factors affecting the adoption of the Internet, amongst UK-based retailers. The specific objectives of this research were as follows:

1. To derive a number of distinct factors that are likely to affect the adoption of the Internet.
2. To establish current levels of Internet adoption amongst the UK's leading retailers.
3. To explore the nature of the relationship between each of the derived factors and the resultant level of Internet adoption.
4. To evaluate which of the derived factors is most influential in determining the resultant level of Internet adoption.

It was envisaged that, by addressing these four issues, important insights into how retail organisations should approach the task of developing an Internet strategy might be generated. The following sections of this paper describe and discuss the primary research that was undertaken to explore these issues.

3. Research Method

The aim of this research is to build upon the finding of previous exploratory, qualitative research, which identified a number of critical factors affecting Internet adoption, based upon a small sample of retailers (Anon, 1999). The chosen research instrument was a questionnaire as it offers the maximum potential to produce results, which are generalisable in terms of the population (McGrath, 1992). The aim of this section is to review the process by which the questionnaire instrument was developed, validated and ultimately targeted and distributed.

3.1 Design of the Internet Retailing Questionnaire

In order to address the four research issues highlighted in section 2 it was necessary to develop a series of measures that would adequately describe an organisation's level of Internet adoption and the factors that had influenced it. To maximise the reliability and validity of the research instrument, and to strongly embed the research within the existing literature, each of the questions was derived either from the literature or as a result of the exploratory qualitative research. The research questionnaire was developed through an iterative process of review and refinement, and it was ultimately divided into three major sections, each of which is briefly reviewed below:

- 1. Respondent classification:** The first section records company details and information specific to the respondent's position and role. This section also sought to classify the company's product activity sector and the size of the organisation in terms of number of outlets, recorded job title of respondents, and level of management responsibility.
- 2. Scale of Internet adoption:** The second section of the questionnaire explores current levels of Internet activity. Accordingly, respondents were asked to describe their progress in developing an active web-site, using a five-item scale ranging from '*no plans to develop a web-site*' through to '*active Web site in existence*'. Given that this study was particularly interested in the use of the Internet for direct sales, respondents were also asked about their plans for the development of an on-line ordering facility.
- 3. Factors affecting Internet adoption:** In order to explore the factors affecting levels of Internet adoption, respondents were questioned on their perceptions of the facilitators, inhibitors, advantages and disadvantages of Internet adoption. The set of potential adoption factors had been primarily derived from the exploratory qualitative research, supported by a thorough review of the relevant literature. Each factor was explored using a five-point Likert scale to indicate the respondents' level of agree/disagreement. Table 1 provides a full list of the questions with respect to the inhibitors and facilitators of Internet adoption, whilst table 2 relates to the comparative advantage factors.

Insert tables 1 and 2 about here

3.2 Validating the Research Instrument

This section focuses on the extensive testing and validation of the survey instrument that was undertaken to determine its potential effectiveness (Reynolds *et al*, 1993) and to avoid mistakes in questionnaire

design (Hague, 1987). Validation of the research instrument consisted of a series of pre-tests followed by a pilot survey. The Pre-test comprised of the following three phases:

- 1. Pre-test I** – A target group of 16 appropriate individuals, including subject specialists, academic experts and retailers, were given draft copies and asked to complete the questionnaire. After completion, de-briefing interviews, as recommended by Reynolds, (1993) were conducted. Individual questions were discussed to eliminate ambiguities, identify missing response categories and to check the validity of the content. After this round of interviews a number of changes were made to the wording and structure of individual questions and layout of the questionnaire.
- 2. Pre-test II** – A similar procedure to the previous test was followed, to further refine the research instrument. In this instance a total of eight practitioners and academics, who hadn't participated in the first phase of pre-testing, were invited to critically review the questionnaire. This exercise resulted in only a few minor changes to individual questions.
- 3. Pre-test III** – At this stage, the questionnaire had undergone a number of significant changes. It was now important to ensure that it would be effective as a means of data collection amongst the target group. Consequently, copies of the questionnaire together with an introductory letter were sent to 18 key retailers. They were asked to use a feedback form to comment on the content validity, wording and clarity, and the overall structure of the questionnaire. In total, 10 replies were received which was considered a good response rate. This exercise confirmed that the questionnaire was now ready for pilot testing.

Having successfully pre-tested and refined the research instrument, a pilot test was conducted to assess the likely response rates and to confirm the questionnaires reliability (Straub, 1989). From the total of 132 retailers randomly selected, a total of 29 replies (response rate: 22%) were received.

3.3 Targeting and execution of Questionnaire

In order to investigate the factors affecting the adoption of the Internet amongst the UK's leading retailers it was necessary to establish a sampling frame that included all such organisations. A '*multiple*' can be defined as a retailer that operates at least ten branches (Levy & Weiss, 1995), and such organisations account for 68% of retail sales in the UK (Business Monitor, 1996; p 27). Consequently, whilst '*multiple*' retailers were the primary target of this research study, those organisations that have an annual turnover in excess of 5 million pounds, were also targeted to ensure that influential single-store retailers, such as Harrods and Selfridges, and mail order organisations were not excluded from this study. Ultimately, the Healy and Baker Retail Directory (1997), which provides a comprehensive list of UK retailers, was used to construct the sampling frame. The survey was mailed to the 1099 organisations in the sampling frame. This posting ultimately resulted in the receipt of 164 useable replies, and the return of 159 questionnaires marked '*addressee not known*', giving an overall response rate of 17.5%.

3.4 Respondent Bias

In order to ensure that the people who have responded to the survey were not systematically different than those who have chosen not to respond, a set of telephone call back interviews were conducted. A random selection was arrived at by using company names from the target population beginning with the letters S to Y (200 cases). The sample did not include cases which had already replied (possible to identify as a high number of respondents supplied their contact details when replying) or had their original mailing returned '*addressee not known*' by the Post Office. Respondents were telephoned and asked to comment on whether they had received the questionnaire, and explain their subsequent course of action. In addition to checking for any particular bias in the sample, this method provided the opportunity to encourage further responses, especially in cases where the questionnaire had not been received or where respondents intended to reply but had not yet done so. In addition, cases were examined to see if they clustered around a particular product activity sector or size of company. None were apparent. Therefore, it was concluded that the sample was free from non-respondent bias.

The first part of the survey was used to record the company / respondent profile, which consisted primarily of product activity sector and company size, as measured by the number of retail outlets. The sector and size data were then used to explore how representative the sample was of the target population of the UK's leading retailers. The results of a chi-squared analysis demonstrated that whilst the sample was very representative in terms of product activity sector the responses were marginally biased towards the larger retail organisations. Consequently, whilst it has been demonstrated that there is no systematic bias in the sample, it should be noted that the results of this research are generally more relevant to the larger retail organisation.

4. Research Results

This section presents a discussion of the research results relating to the four specific research objectives proposed earlier.

4.1 The Identification of Factors

The specific objective for the factor analysis was to establish whether the 37 individual variables, identified in tables 1 and 2, influencing the uptake and adoption of the Internet within the UK retail sector could be consolidated into a far smaller number of distinct factors. Factor analysis is an appropriate technique to use for further analysis of the Internet Retailing Questionnaire data to determine the existence of influencing factors. It is a means of summing information contained in a large number of variables into a smaller set of new composite factors with a minimum loss of information (Hair *et al*, 1997; p 90).

Variables of Interest and Method of Extraction: This section discusses the variables and method of extraction used in the factor analysis. In total, data collected from 164 respondents was examined in terms of two sets of variables (20 variables in the first set and 17 variables in the second set). To simplify interpretation, separate factor analyses were run on each set of variables. Before conducting the factor analysis, it is important to ensure that the data matrix has a sufficient number of correlations to justify the

application of factor analysis. In this instance, measure of sampling adequacy (MSA) scores of 0.712 and 0.834 were computed, for variable sets 1 and 2 respectively. Therefore, both of the data matrices were considered to show sufficient correlation. The ratio of the number of variables to the sample size is also an important prerequisite for factor analysis success. Hair *et al*, (1997; p 98) suggest that the minimum for an acceptable ratio is at least five observations for each variable included in the analysis. In this study, the ratios of respondents to variables were 8.2:1 for set 1 and 9.1:1 for set 2. Consequently, factor analysis is an appropriate tool in these circumstances.

Principle components factor analysis, with a varimax rotation was the method used to examine the whole range of interrelated relationships in the data sets. Principle component factor analysis aims to convert a set of interrelated variables into a number of unrelated linear combinations of these variables (Churchill, 1995). Furthermore to obtain the most adequate interpretation of the variables under investigation rotation is encouraged as it can simplify the factor structure and aid interpretation Hair *et al*, (1997; p 106). It should be noted that the choice of principle component analysis with varimax rotation is consistent with previous work by Teo *et al* (1997).

Results of Factor Analysis: R type factor analysis using principle component extraction, with varimax rotation, was used as a mechanism for summarising and reducing the data in each of the two sets of variables. The application of the ‘*Scree*’ test and a review of the ‘*Eigen*’ values (Hair *et al*, 1995 p 103) was used to determine the most statistically significant number of factors for each of the variable sets. Ultimately, four factors were identified from the twenty variables in variable set 1. The factor loadings, and associated ‘*Eigen*’ values, for variable set 1 are presented in table 3. Using a Similar approach, six distinct factors were identified, as presented in table 4, from the seventeen variables in variable set 2.

Insert tables 3 and 4 about here

Interpreting and Naming Factors: Having arrived at a satisfactory number of statistically significant factors, the aim of the remainder of this section is to determine appropriate names for each factor. Each of the ten derived factors is briefly reviewed and named below:

- Factor 1:** The first factor has six significant factor loadings, all of which are positively correlated. The ‘*Internet access of the respondents target audience*’ is the most highly correlated variable followed by ‘*level of Internet awareness*’ and ‘*computer literacy*’ of the responding organisations target audience. The ‘*gender*’ and ‘*age*’ of the existing target audience are followed in terms of significance by suitability of current product range for Internet retailing. This factor was named the **Internet target segment** because the contributing variables emphasised issues associated with target market and segmentation issues for Internet consumer markets. It should be noted that this is the strongest factor, as it accounts for 31.9% of the variance and it also has the with the highest ‘*eigen*’ value.

2. **Factor 2:** This factor consists of 5 significant variables. ‘*Senior management support*’ is a significant participating variable, as are the ‘*management vision of the usefulness of the Internet*’ and the ‘*company’s Internet development strategy*’. Additionally, the availability of resources, in terms of both the level ‘*funding*’ and ‘*human resources*’, contributed significantly to this construct. Ultimately, this factor was named **Internet strategy**, as all five variables relate to the organisations strategic vision and willingness to provide appropriate resources to support its implementation. Other studies within the field of technology have found top management support and vision to be an important part of organisational strategic adoption of innovation process (Premekumar et al 1997: Teo *et al* 1997).

3. **Factor 3:** This factor grouping consists of variables from each of the sub-sets of the environmental component. Three of the variables focus strongly on issues, relating to the organisation’s perception of the Internet market; namely the ‘*size*’ and ‘*maturity*’ of the Internet market and ‘*other retailers’ on-line activities*’. The final variable, the ‘*technical reliability of the Internet*’, doesn’t perhaps, at first sight, sit comfortably with the other three. However, it may well be that organisations that have a positive perception of the development of the Internet market, in their own sector, also have a more positive attitude towards its technical capabilities. Ultimately, this factor was named **Internet market-place**, because of its emphasis on the Internet market and the concept that the Internet is a dynamic link between retailer and consumer.

4. **Factor 4:** The final factor from set 1 consisted of five variables: ‘*company’s technological infrastructure*’, ‘*company’s logistical infrastructure*’, ‘*web design skills*’, ‘*web developer’s promotional offers*’ and ‘*outsourcing of functions*’. This factor was named **infrastructure and development capability**, given that all five constituent variables are associated with an organisation’s readiness to exploit the Internet, in terms of an appropriate infrastructure and the ability to develop a web site. would be an appropriate name. It should be noted that whilst the final variable, ‘*outsourcing of functions*’, has a factor loading of 0.383, which is below the minimum recommended loading of 0.4 (Hair et al’s, 1995 p.385). However, given that it only just misses the cut-off, and it forms a coherent group with the other four variables, it was retained as in the factor.

5. **Factor 5:** The first factor from set 2 consists of four variables; ‘*method of communication with customers*’, ‘*expanded customer services*’, ‘*speed of communication with customers*’ and ‘*means of collecting market research data*’. These variables form a coherent group, all of which have a strong focus on the Internet’s ability to facilitate communications between the retailer and their customers. Consequently, this factor was named **Internet communications**. It is the most significant factor, as it accounts for 24% of the variance, and it has the highest ‘*eigen*’ value (4.311).

6. **Factor 6:** The ‘*cost of logistics to support the on-line operation*’ is the most significant variable in this factor. Two additional variables, namely the ‘*cost of supporting two different channels*’ (direct sales via the Internet and fixed retail store operation), and the ‘*cost of restructuring the*

organisation', also contributed. Because of its strong emphasis on the cost associated with Internet retailing, the factor is named **cost of Internet trading**.

7. **Factor 7:** This factor also has three constituent variables, all of which are associated with the financial potential of the Internet; '*low running costs of on-line operations*', '*low set up costs of on-line operations*' and a '*reduction in need for future investment in fixed location store development*'. The factor is named **Internet cost opportunity** because the underlying variables suggest that there is an opportunity to derive commercial advantage by maximising immediate and mid-term cost saving offered by the Internet.
8. **Factor 8:** The three variables in this factor are all associated with the Internet's ability to foster the development of new markets; namely '*increased access to global markets*', '*increased access to niche consumer markets*' and '*increased trading hours*'. Consequently, the factor is named **market development opportunity**.
9. **Factor 9:** The ninth factor contains only two variables; '*media reporting of the negative aspects of the Internet*' and '*concerns about on-line security*'. Accordingly, the factor is named **concerns**, as both the variables are associated with negative aspects of the Internet, which have been widely reported in the literature.
10. **Factor 10** The final factor also consists of just two variables; the '*consumer's perceived preference for going shopping*' and the '*Internet's inability to convey all of the different types of sensual information*'. Consequently, this factor is named **consumer preferences**, because of its focus on perceptions about consumer behaviour focus.

Having demonstrated that each of the ten derived factors form coherent groups of associated variables, which can be given appropriate names, it is also important to test their validity and reliability.

Validity and reliability of Factor analysis: Throughout this research project, the importance of striving for maximum validity is emphasised. The internal reliability of each factor was, therefore, examined using Coefficient '*alpha*' (Hair et al, 1997; p 118). Ideally, alpha scores should exceed 0.70, although scores of 0.60 and above are acceptable DeVellis (1991). In this instance, six of the factors can be classed as '*ideal*' (factors: 1-3 & 4-6), two can be classed as '*acceptable*' (factors: 4-5), whilst the two remaining factors (factors: 9-10) have alpha scores marginally under the minimum cut-off value of 0.60. The low alpha scores for the final two factors is not perhaps surprising as both factors have only two constituent items each. Consequently, as this research is of an exploratory nature these two factors (factors: 9-10) were ultimately retained, in the interests of completeness.

4.2 Current Levels of Internet Adoption

The extent of Internet adoption was measured in two ways. Firstly respondents were asked about their general progress in adopting the Internet, using a five item scale, ranging from '*no Internet activity*

planned’, through to the existence of an ‘*active web-site*’. Secondly, respondents were asked about their plans with respect to using the Internet as a channel for on-line ordering, using a four item scale, ranging from ‘*no facilities planned*’ through to ‘*active on-line ordering facility*’. The results presented in tables 5 and 6 demonstrate that the adoption of the Internet amongst the UK’s leading retailers is still relatively modest.

Insert tables 5 & 6 about here

The findings are of particular interest and significance when set alongside comparable figures for Internet adoption amongst US retailers. For example, whilst this study has found that only 37% of the UK’s leading retailers have established an active web-site, a comparable study by Griffith and Krampf (1998) indicates the level of uptake in the US is already 64%. Similarly, whilst this study found only 18% of UK retailers were engaged in on-line selling, a recent Ernst and Young study (1999) reported that 39% of U.S retailers were already engaging in on-line shopping. Consequently, given the global nature of the Internet, many UK retailers might find themselves at a competitive disadvantage, with respect to their US counterparts.

4.3 The Relationship between Individual Factors and the Level of Internet Adoption

Having identified ten distinct and meaningful factors, it is possible to explore the relationship between each of these and the level of Internet adoption, measured both in terms of the creation of an interactive web-site in general terms and its use for on-line sales, in particular. These relationships were explored by conducting an analysis of variance (ANOVA), to determine whether observed differences among sample means can be attributed to chance or whether statistically significant differences exist (Freund *et al.*, 1993: pp 525-540). The results for the adoption of an active web-site are presented, before the findings with respect to the use of the Internet for on-line ordering are discussed.

The adoption of an active web-site: An inspection of the data, in table 7, suggests that levels of Internet adoption are significantly influenced by all the factors, with the exception of ‘*concerns*’ (factor 9). To interpret the mean success scores, it must be remembered that the higher the score, the more strongly a particular factor influenced an organisations level of Internet adoption, and *vice versa*. Baring this in mind, the three distinct patterns of significant relationship, as described below, can be identified:

1. **Positive Influences:** This group of factors (1, 2, 3, 4, 6 & 7) is characterised by a fairly steady rise in mean values from ‘*non-adopters*’ through to the adoption of an ‘*active web-site*’. The implication of this pattern is that these six factors all exert a positive influence on an organisation’s adoption of the Internet. Consequently, there is an increasing recognition of the importance and influence of factors, such as the availability of an appropriate ‘*infrastructure and development capability*’ or the viability of the ‘*Internet market-place*’, grows as an organisation makes progress in the adoption of an ‘*active web-site*’

2. **Negative Influences:** Two of the factors (8 & 10) are exerting a negative influence. It can be seen that there is a steady decline in mean values from ‘*non-adopters*’ through to ‘*active web-site*’. The implication of this pattern is that both these factors have strongly influenced the ‘*non-adopters*’ to refrain from investing, but the influence of the ‘cost of Internet trading and consumer sensitivity gradually weakens as an organisations progresses through to an ‘*active web-site*’.

3. **Variable Influences:** One of the nine significant relationships (factor 5) displays a distinctly different pattern to the others. Whilst the influence of ‘*Internet Communications*’ rises steadily from the ‘*non-adopter*’ through to the ‘*active planning*’ phase, it then starts to decline as the organisation progresses through ‘*active development*’ through to ‘*interactive web-site*’. The implication of this is that whilst the Internet’s ability to facilitate communications strongly influences an organisation to commence an Internet project, once the project is underway, its perceived importance gradually diminishes.

Insert table 7 about here

An inspection of the F ratios in table 7 also indicates that it is two of the ‘*positive influences*’, namely, the presence of an ‘*Internet retailing strategy*’ and the availability of an appropriate ‘*Internet target segment*’, that are exerting the strongest influence.

The adoption of on-line ordering: This section examines the affect of the ten critical factors on the extent of adoption of the Internet as a channel for direct sales. Table 8 shows the results of a one-way ANOVA for these variables. As for the adoption of an interactive web-site, an inspection of the data indicates that, all the significant relationships (all factors other than no. 9) can be classed as either having positive, negative or variable influences. More specifically, it can be seen that, with the exception of factors 1 and 7 that have both moved from a ‘*positive*’ to a ‘*variable*’ influence, all the factors are adopting the same style of relationship, as they were for the adoption of an ‘*interactive web-site*’. This suggests that the factors affecting on the adoption of an on-line sales facility are not dissimilar to those influencing the development and implementation of an ‘*active web-site*’.

Insert table 8 about here

An inspection of the F ratios in table 8 indicates that it is two of the ‘*positive influences*’, once more, namely, the belief that there is a viable ‘*Internet market-place*’ and the availability of an appropriate ‘*Internet target segment*’, that are exerting the strongest influence.

4.4 The Relationship between All Factors and the Level of Internet Adoption

Whilst ANOVA is a very useful tool for exploring the relationships between each of the ten individual factors and specific dependent variables, it does not provide a holistic picture of the relative importance of the factors. Discriminant analysis, which is appropriate in situations where a statistical relationship is being sought between a single categorical dependent variable, and a number of metric independent

variables, is therefore a highly appropriate tool for providing a more holistic picture. Discriminant analysis is appropriate in situations, such as this study, where there are two or more groups that need to be discriminated between (Hair et al; 1997;p 245). In this analysis, however, the number of groups were reduced to two (those organisations already using, or planning to use, the Internet, as opposed to those who aren't) to ensure that none of the minimum group membership criterion were broken and also to make the results easier to interpret.

Hair et al (1995: p282) suggest that discriminant analysis is only appropriate in situations where there is a minimum ratio of 5-to-1 between the number of responses and the number of independent variables. With a sample size of 164 and ten independent variables, this minimum criteria is very comfortably surpassed. Furthermore, they suggest that all groups used in discriminant analysis should contain at least 20 observations. The discussion of the application of discriminant analysis in the remainder of this section, demonstrates that this minimum threshold value is, once more, comfortably exceeded. Finally, because the objective of this analysis is to determine which variables are the most efficient in discriminating between those organisations who are adopting the Internet, as opposed to those who aren't, a *'stepwise'* approach (Hair et al, 1997; p 284) was adopted. The remainder of this section presents the results of the application of discriminant analysis to explore the relationship between the ten factors and firstly the adoption of an *'interactive web-site'*, and then for the uptake of *'on-line ordering'*.

The adoption of an active web-site: The results of the discriminant analysis, as presented in table 9, demonstrate that the overall percentage of cases correctly classified is 75%. In order to determine whether this level of predictive accuracy is statistically significant, a number of different tests have been proposed in the literature. Firstly, Crook et al (1992) suggest two tests, the minimum chance criterion (C_{MAX}) and the proportional chance criterion (C_{PRO}), to determine whether the predictive accuracy is better than chance. In this instance the predictive accuracy of 75% is far higher than the C_{MAX} (61.2%) and the C_{PRO} (52.5%). Furthermore, the predictive accuracy as measured by Press's Q statistic (Hair et al (1992; p 290) is also statistically significant. It should also be noted that the ability of discriminant function generated by the analysis, to discriminate between groups, is highly significant (.000).

Insert table 9 about here

Hair et al (1997; p294) suggest that *'all variables entered into the function, and generally any variables exhibiting a loading of ± 0.30 or higher are generally considered substantive'*. Consequently, it can be seen from the data presented in table 10 that the two variables entered into the discriminant function, namely the presence of an *'Internet retailing strategy'* and an appropriate *'Internet target market'*, are the most important discriminators of the level of Internet adoption. However, three other variables: the availability of *'Internet development resources'*; the recognition of a *'market development opportunity'* and appropriate *'market dynamics'*, are also important discriminators. Furthermore, it can also be seen that these five variables also have the highest univariate F ratios, which reinforces the discriminatory importance of these variables.

Insert table 10 about here

The Adoption of on-line ordering: The results of the discriminant analysis, as presented in table 11, demonstrate that the overall percentage of cases correctly classified is 79%. This level of predictive accuracy is also better than chance, in this instance the C_{MAX} value is 73.9% and the C_{PRO} value is 61.0%. Furthermore, the predictive accuracy as measured by Press's Q statistic (Hair et al (1992; p 290) is also statistically significant. It should also be noted that the ability of discriminant function generated by the analysis, to discriminate between groups, is highly significant (.000).

Insert table 11 about here

Table 12 presents a number of important statistics that are important for interpreting the results of the discriminant analysis. It can be seen from this data that the two variables entered into the discriminant function, namely an appropriate '*Internet target segment*' and a belief in the viability the '*Internet market-place*', are the most important discriminators of the adoption of on-line ordering of goods facilities. However, three other variables: the recognition of a '*market development opportunity*'; the perceived importance of '*Internet communications*' and the availability of an appropriate '*Infrastructure and development capability*', are also important discriminators. Furthermore, it can also be seen that these five variables also have the highest univariate F ratios, which reinforces the discriminatory importance of these variables.

Insert table 12 about here

5 Discussion: Factors Affecting the Adoption of the Internet in the UK Retail Sector

Having identified the major factors affecting the adoption of the Internet amongst the UK's leading retailers, it is important to review the findings and contextualise them within the relevant literature. Furthermore, the implications of this study, both for the retail practitioners and researchers, will also be reviewed, as will the potential limitations of this study. When interpreting the results with respect to the factors affecting Internet adoption, it is clear that all factors, other than '*concerns*' are exerting a significant influence on the decision to adopt web-site technology. Furthermore, it can be seen that it is the factors associated with potential inhibitors and facilitators (factors: 1-4), as opposed to the relative advantage factors (numbers: 5-10) that are exerting the strongest influence. In particular, the marketing oriented factors, namely operating in an appropriate '*Internet target segment*' (factor 3), and a belief in the viability of the '*Internet market-place*' (factor 4) have strongly influenced organisations, with respect to both the adoption of an active web-site, and its use for on-line ordering.

It is also interesting to compare the factors that are affecting the adoption of active web-sites, in general, as opposed to on-line ordering, in particular. Whilst there are many similarities between the two sets of factors, there are some important differences in emphasis. For example, whilst the key drivers for the development of an on-line ordering facility are primarily concerned with marketing considerations (factors 3, 4 & 7), the motivation for the provision of an active web-site is more dependent upon the

strategy, commitment, infrastructure and capabilities of the host organisation (factors 1 & 2). This latter finding aligns reasonably well with the work of Teo et al (1997) who have also identified the importance of factors such as technological policy, senior management commitment and an appropriate infrastructure, in influencing the adoption of the Internet. These findings are also consistent with previous work assessing the diffusion of technological innovations (e.g.: Grover, 1993; Zmud, 1984). By contrast, the identification of the importance of marketing factors, in particular, operating in an appropriate '*Internet target segment*' and a belief in the viability of the '*Internet market-place*', especially with respect to the adoption of on-line ordering, is an important new contribution to knowledge.

These findings offer a number of important implications for managers within the retail sector. The most important factor, in this context, is probably the '*Internet target segment*'. More specifically, any organisation operating in an appropriate '*Internet target segment*', that is reluctant to invest in Internet technology and develop a web presence, faces the threat of having their customers aggressively targeted by their more technologically innovative competitors. Additionally such organisations will probably need to educate their managers on the viability of the '*Internet market-place*' and take steps to develop an '*Internet retailing strategy*' and acquire an appropriate '*infrastructure and development capability*'. For those organisations not operating in an appropriate '*Internet target segment*' the dangers are less acute, although as the importance of the Internet market grows, such companies might be advised to reposition their goods and services to meet the needs of the Internet consumer.

This research also provides some important insights into how retail organisations might approach the task of developing a coherent Internet strategy, the need for which has been sign-posted in previous research (Doherty et al, 1999; Evans & Wurster, 1997). For example, the ten factors, or possibly the 37 variables from which they are derived, could be used as the basis for assessing an organisations readiness for adopting the Internet, evaluating the potential areas where competitive advantage might be attained and ultimately for identifying the set of actions necessary for Internet adoption. It should also be noted, that given the importance of the marketing-oriented factors, any Internet strategy must be fully integrated with the retailer's overall marketing strategy. Furthermore, this research should also be of interest to the researcher, as it has identified and validated many new variables, in addition to the ten distinct factors, associated with the adoption of Internet, all of which might be usefully incorporated in future research.

Research into the adoption of innovative technology, within the organisational context, is an ambitious undertaking, and therefore contains a number of inherent limitations. In particular, the adoption of the survey format results restricts the range of issues and constructs that can be explored, the selection of a very narrow sampling frame reduces the generalisability of the results and finally there is potential response bias associated with the 'single-informant'. Whilst the study provides many interesting and novel insights, these limitations do highlight the need for follow-up studies to be conducted employing different methods, and target different populations and respondents.

6 Concluding Remarks

This empirical study has applied rigorous statistical methods in the development of a taxonomy of distinct and meaningful factors that have the potential to influence the uptake of the Internet within the retail sector. When linked to measures of Internet adoption, it has been shown that certain factors are far more influential than others. In particular, it has been demonstrated that operating in an appropriate market sector and having a positive view of the viability of the Internet, when coupled with an appropriate strategy, level of commitment, infrastructure and capability, are of particular significance. Whilst the findings will be of most significance to those organisations operating within the UK retail sector, it is likely that they will also be of interest in countries where the current level of Internet activity is similar to the UK. Finally, given the highly dynamic nature of the Internet market-place, it is important that studies such as this are regularly conducted to detect changes in the level of adoption, as well as variations in the importance of factors that influence it.

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Table 1: Potential Inhibitors and facilitators of Internet adoption (Variable set 1).

Variable Description	Primary Sources
Level of funding available retail development on the Internet	Teo <i>et al</i> , (1997)
Senior management's level of commitment	Teo <i>et al</i> , (1997)
Web design skills of company personnel.	Interviews
Company's technological infrastructure	Teo <i>et al</i> , (1997)
Company's logistical infrastructure	Interviews
Level of human resources available	Interviews; Teo <i>et al</i> , (1997)
The management vision of the usefulness of the Internet	Interviews; Teo <i>et al</i> , (1997)
Suitability product range for Internet retailing	De Kare-Silver, (1998)
Company's target customers' levels of access to the Internet	Parker & Guildford, (1996); Hoffman & Novak, (1998)
Company's target customers' levels of computer literacy	Interviews
Company's target customers' levels of Internet awareness	Interviews
Gender of company's target customers	Interviews
Age of company's target customers	Interviews
The current size of on-line market place	Interviews
The maturity of Internet market	Interviews
Other retailers' on-line retail activities	Cockburn & Wilson, (1996)
Technical reliability of the Internet	Interviews
Web developer's promotional offers	Interviews
The company's Internet development strategy	Interviews
Outsourcing of functions not available within the company	Interviews

Table 2: Potential Advantages and Disadvantages of Internet adoption (Variable set 2).

Issue / Content	Sources
High cost of running on-line and off-line operation.	Interviews
High cost of the logistical support of on-line sales operation.	Interviews; Morgansky (1997)
Consumer's perceived shopping preferences	KPMG (1997) Jarvenpaa & Todd (1997)
High cost of restructuring operations for on-line operation.	Interviews
Concerns about on-line security	Chappella, (1997) O'Keefe, (1998)
Media reporting of the negative aspects of the Internet	Interviews
Low set up costs of on-line operation	Rowley, (1996); O'Keefe, (1998); Aldridge & Darnwood, (1998)
Low running costs for the operation of the Internet	Pavit, (1997); Hooi-Im Ng et al (1998)
Increased trading hours e.g. 24 hours a day 365 days a year	
Increased access to global consumer markets	Van Tassel & Weitz (1997); Cronin (1996)
Increased access to niche consumer markets	Aldridge & Darnwood (199?); Interviews
A new means of collecting Market Research Data	Davis (1997)
Reduction in need for future investment	Interviews; OXRIM, (1998).
The rapid speed of communication with customers	Kannan (1998)
A new and innovative method of interaction with consumer	Interviews
Expanded customer services	Interviews
Internet's inability to convey sensual information	Interviews

Table 3: Variable Set 1- Factors and Loadings for Underlying Variables.

Component	Factor 1	Factor 2	Factor 3	Factor 4
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Level of funding available retail development on the Internet	8.1 E-03	0.757	9.023E-02	.201
Senior management's level of commitment	0.136	0.864	9.9 E-02	2.9 E-02
Web design skills of company personnel.	0.220	0.431	9.7 E-02	0.522
Company's technological infrastructure	0.157	0.333	1.2 E-02	0.744
Company's logistical infrastructure	0.303	0.166	2.9 E-02	0.729
Level of human resources available	0.236	0.545	-6.2 E-02	0.379
The management vision of the usefulness of the Internet	0.183	0.844	6.1 E-02	-3.6 E-02
Suitability product range for Internet retailing	0.646	0.227	1.3 E-02	0.123
Company's target customers' levels of access to the Internet	0.910	8.5 E-02	0.157	-4.8 E-03
Company's target customers' levels of computer literacy	0.880	0.172	9.4 E-02	4.3 E-03
Company's target customers' levels of Internet awareness	0.888	0.147	7.8 E-02	2.9 E-02
Gender of company's target customers	0.708	-1.3 E-02	7.2 E-02	6.6 E-02
Age of company's target customers	0.701	5.8 E-02	9.8 E-02	0.288
The current size of on-line market place	0.495	0.140	0.651	-1.5 E-02
The maturity of Internet market	0.308	0.190	0.742	-6.4 E-02
Other retailers' on-line retail activities	2.9 E-02	0.164	0.766	0.110
Technical reliability of the Internet	6.4 E-02	3.3 E-02	0.710	0.359
Web developer's promotional offers	-0.174	-0.222	0.399	0.484
The company's Internet development strategy	6.1 E-02	0.721	0.312	0.216
Outsourcing of functions not available within the company	-7.846E-02	3.4 E-02	0.259	0.383
Percentage of variability explained	31.9%	13.05%	10.1%	7.4%
Eigen Values	6.388	2.692	2.028	1.469

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 10 iterations.

Table 4: Variable Set 2 - Factors and Loadings for Underlying Variables.

Variables	Factors					
	5	6	7	8	9	10
High cost of running on-line and off-line operation.	-9.4 E-03	0.835	6.4 E-02	-0.137	5.7 E-02	-2.4 E-03
High cost of the logistical support of on-line sales operation.	-4.5 E-02	0.866	-0.112	6.3 E-02	-3.8 E-02	0.228
Consumer's perceived shopping preferences	-1.6 E-02	0.210	6.2 E-02	-9.5 E-02	5.8 E-02	0.772
High cost of restructuring operations for on-line operation.	-2.8 E-02	0.774	-0.174	0.117	0.212	0.224
Concerns about on-line security	-5.8 E-02	0.183	-0.125	0.184	0.723	6.0 E-02
Media reporting of the negative aspects of the Internet	6.5 E-02	-1.9 E-02	4.9 E-02	-5.5 E-02	0.815	0.116
Low set up costs of on-line operation	0.164	-0.149	0.836	0.163	-0.167	-7.1 E-03
Low running costs for the operation of the Internet	9.8 E-02	-0.131	0.886	0.232	-6.9 E-02	5.0 E-02
Increased trading hours e.g. 24 hours a day 365 days a year	0.166	-7.7 E-02	0.408	0.546	0.224	0.166
Increased access to global consumer markets	0.305	-9.7 E-03	4.3 E-02	0.746	-6.3 E-02	-0.161
Increased access to niche consumer markets	0.310	7.5 E-02	0.123	0.743	9.5 E-02	-0.172
A new means of collecting Market Research Data	0.549	0.186	5.0 E-02	6.4 E-02	0.289	-0.378
Reduction in need for future investment	0.270	0.224	0.625	-0.296	0.297	-0.204
The rapid speed of communication with customers	0.816	-6.0 E-03	0.156	0.177	-1.3 E-02	4.9 E-02
A new and innovative method of interaction with consumer	0.862	-7.0 E-02	0.164	0.162	-4.7 E-02	5.4 E-03
Expanded customer services	0.827	-0.104	9.0 E-02	0.326	8.2 E-03	5.4 E-02
Internet's inability to convey sensual information	5.9 E-02	0.302	-9.6 E-02	-0.108	0.282	0.543
Percentage of variability explained	23.95%	16.69%	8.95%	7.18%	6.19%	5.71%
Eigen Values	4.311	3.005	1.612	1.291	1.113	1.027

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.

Table 5 Adoption of Active Web-site

No Internet activity planned	URL Only	URL and actively planning	URL and actively developing	Active Web site
35 (21%)	32(19.6%)	18 (11%)	17 (10.4%)	62 (37.8%)

Table 6 Adoption of On-line Ordering Facility

No Activity planned	Planned to include in Web site	Actively being developed	Already present in Web site	Missing cases
43 (26.2%)	55 (33.5%)	20 (12.2%)	30 (18.3%)	16 (9.85)

Table 7: Mean Ratings and Significance Levels for Internet Adoption

Factor name	Non adopters	URL Only	URL and planning	URL and developing	Active Web site	F ratio	Sig.
1 Internet retailing strategy	2.31	2.46	3.19	2.97	3.24	10.70	0.00
2 Infrastructure & development capability	2.38	2.53	2.81	2.88	3.00	6.27	0.00
3 Internet target segment	2.29	2.59	3.19	2.96	3.21	8.25	0.00
4 Internet market-place	2.52	2.61	3.10	3.11	2.97	4.22	0.01
5 Internet communications	3.20	3.28	3.86	3.70	3.63	3.11	0.02
6 Internet cost opportunity	2.76	2.81	3.09	3.14	3.23	2.04	0.09
7 Market development opportunity	3.11	2.97	3.37	3.50	3.65	3.29	0.01
8 Cost of Internet trading	3.22	3.06	2.96	2.92	2.36	4.75	0.00
9 Concerns	2.78	2.45	2.88	2.66	2.65	0.74	0.56
10 Consumer sensitivity	3.80	3.36	3.68	2.91	3.05	4.73	0.00

Table 8: Mean Rating and Significance Levels for the Ordering of Goods On- line

Factor	None	Planning	Developing	Active	F ratio	Sig.
1 Internet retailing strategy	2.53	2.88	3.29	3.24	5.56	0.00
2 Infrastructure & development capability	2.50	2.80	3.00	3.01	4.77	0.00
3 Internet target segment	2.24	3.03	3.09	3.35	13.12	0.00
4 Internet market-place	2.42	2.94	3.19	3.20	10.90	0.00
5 Internet communications	3.09	3.58	4.02	3.62	6.88	0.00
6 Internet cost opportunity	2.73	3.10	3.23	3.25	2.48	0.06
7 Market development opportunity	2.82	3.46	3.78	3.58	5.90	0.00
8 Cost of Internet Trading	3.07	2.72	2.75	2.28	3.34	0.02
9 Concerns	2.57	2.90	2.70	2.40	2.08	0.11
10 Consumer sensitivity	3.54	3.46	2.90	2.83	4.90	0.00

Table 9: Classification matrix for the ‘Adoption of an Active Web-site’ analysis.

		Predicted group membership		Totals
		Non adopters / URL only	URL & planning / URL & developing / Active web-site	
Actual group membership	Non adopters / URL only	37 59.7%	25 40.3%	62
	URL & planning / URL & developing / Active web-site	14 14.9%	80 85.1%	94
Totals		51	105	156

Percent of grouped cases correctly classified: 75 percent [37 + 80] / 156

Table 10: Interpretative measures for the ‘Adoption of an Active Web-site’ analysis.

Factors	Standardised	Discriminant		Univariate	
	Weights	Loading		F Ratio	
	Value	Value	Ranking	Value	Ranking
1 Internet retailing strategy	0.733	0833	1	40.797	1
3 Internet target segment	0.562	0693	2	29.655	2
2 Infrastructure & development capability	NI	0352	3	22.951	3
7 Market development opportunity	NI	0343	4	11.675	5
4 Internet market-place	NI	0312	5	15.947	4
5 Internet communications	NI	0286	6	11.272	7
10 Consumer sensitivity	NI	-0.189	7	7.822	8
6 Internet opportunity cost	NI	0168	8	7.800	9
8 Cost of Internet trading	NI	-0.166	9	11.506	6
10 Concerns	NI	-0.120	10	0.27	10

NI: Not included in the stepwise solution

Table 11: Classification matrix for the ‘Adoption of On-line Ordering’ analysis.

		Predicted group membership		Totals
		No Facilities for the on-line ordering of goods	Planning / Developing / Active facility for on-line ordering of goods	
Actual group membership	No Facilities for the on-line ordering of goods	17 44.7%	21 55.3%	38
	Planning / Developing / Active facility for on-line ordering of goods	8 7.8%	95 92.2%	103
	Totals	25	116	141

Percent of grouped cases correctly classified: 79 percent $[17 + 95] / 141$

Table 12: Interpretative measures for the ‘Adoption of On-line Ordering’ analysis.

Factors	Standardised	Discriminant		Univariate	
	Weights	Loading		F Ratio	
	Value	Value	Ranking	Value	Ranking
3 Internet target segment	0.655	0.874	1	35.644	1
4 Internet market-place	0.530	0.792	2	28.188	2
7 Market development opportunity	NI	0.405	3	16.123	3
5 Internet communications	NI	0.355	4	15.352	4
2 Infrastructure & development capability	NI	0.312	5	11.563	5
1 Internet retailing strategy	NI	0.277	6	10.969	6
6 Internet opportunity cost	NI	0.225	7	6.912	7
10 Consumer sensitivity	NI	-0.122	8	3.804	9
9 Concerns	NI	0.053	9	0.680	10
8 Cost of Internet trading	NI	-0.034	10	5.737	8

NI: Not included in the stepwise solution