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Abstract
In October 2006, the Broadband Wales Observatory undertook case study research into the change, impact and benefits of broadband, on a diverse selection of SMEs (including micro and SOHO businesses) and citizens from across Wales, UK. This paper explains the research approach and method, and presents an overview of the findings from 24 case study reports. It concludes that all of the cases have embraced ADSL broadband, increasing their use and dependency on Internet communication methods, and that many have also re-engineered their business processes to achieve improved operational efficiencies and productivity gains.

Keywords: eCommerce, Broadband, SMEs

1 Background to the Case Research

The Welsh Assembly Government's Broadband Wales (BBW) Programme was officially launched in July 2002, with the aim of improving the availability of broadband in Wales, UK, for the public sector, the business sector and the general public, over 5 years. At that time, of the 439 BT (the incumbent) telephone exchanges in Wales only 30 (or 7%) were Asymmetrical Digital Subscriber Line (ADSL) enabled, which equated to 35% of the Welsh population having access to broadband via this technology. Market statistics for ADSL take-up were limited, but known to be exceedingly low.

By the end of 2006, all but two of the 439 exchanges have been ADSL enabled and according to BT, more than 99.5% of premises in Wales are connected to a DSL enabled exchange.

One of the roles of the Broadband Wales Observatory www.bbwo.org.uk is to gather information on broadband developments in Wales and to assist in monitoring and evaluating the achievements of the BBW Programme. During the final year of the Programme, the Observatory was contracted to undertake 24 broadband case studies to "demonstrate the impact and benefits of broadband to

the people and businesses in Wales, Welsh Assembly Government policy owners and other key stakeholders in a tangible way."

This paper describes how the case study research was undertaken, presents the key findings, and then draws conclusions on the dependence of small to medium-size enterprises (SMEs) and citizens on their broadband Internet connection. It also provides an additional insight into the impact and benefits of broadband captured by the surveys conducted, on a UK national basis, by the Institute of Directors and, on a regional basis, by the South West Regional Development Agency.

1.1 Aims

The primary aim of the research is to demonstrate how broadband has effected change, made an impact and given benefits to the primary unit of analysis (business, organisation or citizen) and any secondary units of analysis (relevant stakeholders) used for each case, in terms of the:

- Changes that have occurred over time since getting broadband;
- Applications and drivers for adoption and usage of broadband;
- Quantified benefits of using broadband;
- Impact on profit, derived from reductions in cost and increase in revenue, as a result of using broadband.

The inclusion of secondary units of analysis in the case is expected to achieve a more complete, or two-way view, of the change, impact and benefits of broadband on the primary unit of analysis.

Each case would also be considered within the broader context of its industry sector or consumer segment and Welsh Assembly Government's policy areas. This would help to give readers of the individual case study reports an overview of the marketing environment for each primary unit of analysis, and examples of what other similar organisations or citizens are doing, and the benefits they are experiencing, from using broadband.

All 24 case studies had to be approved by eWales, the Welsh Assembly Government department managing the BBW Programme, by the end of December 2006. In addition, the case study reports were designed so that cross case study analysis could be undertaken.

1.2 Proposition and Enquiry Questions

The proposition for the case studies was implicitly given *a priori* by the Case Study Product Description and can be explicitly stated as:

"The increased availability and adoption of broadband in Wales has resulted in change, impact and benefits for businesses, organisations and citizens."

To test the validity of the proposition, a set of enquiry questions was crafted in accordance with Robert K Yin's strategy that the questions should ask "how" or "why" about a contemporary set of events over which the investigator has little or no control. The 4 questions used for all the case studies were:

1. How has the case benefited from using broadband over time?

2. How has the case changed its operational tasks, activities and processes, due to using broadband over time?
3. How has using broadband changed the operational costs and income of the primary unit of analysis over time?
4. Why did the case implement broadband or broadband applications?

The questions were posed to drive the research by capturing the change over time, 'pre' and 'post' broadband, across the operational areas of the primary units of analysis in terms of financial metrics so that an Impact on Profit could be estimated.

2 Investigation

It was estimated that it would take 8 to 10 man-days to complete the research for each case, including writing the reports. This works out in total to 192 to 240 man-days of work, excluding project management and quality reviews. Therefore, to complete the 24 case studies by the end of 2006 would require a team of case investigators and quality reviewers and a systematic production approach.

2.1 Approach

During the summer months of 2006, work commenced on the design of the method and report outputs and the creation of an execution plan. The first challenge was to get the resources in place to undertake the investigative research and to identify suitable primary units of analysis for each case.

A team of investigators was recruited from internal staff; additionally, external consultants from across Wales who were known to the Observatory were invited to take part. The first task of the team of investigators was to identify a prospective primary unit of analysis, and submit to the Observatory an 'Investigators Case Study Proposal' form, which profiled the units of analysis of the case. With this information, the Observatory was able to qualify the suitability of each case against the selection criteria defined by eWales.

2.2 Selection of Primary Units of Analysis

The cases were selected so that, together, they covered all of the following criteria:

- The main Welsh Assembly Government policy areas
- A cross section of different-sized businesses from the main industrial sectors and charitable/voluntary/community organisations
- Small Office Home Office (SOHO), including people who work from home
- Consumers including at least one family and one older person or 'silver surfer'

As 94% of the 171,000 businesses in Wales are classed as micro businesses, the majority of the cases researched included a primary unit of analysis with less than 10 employees, as shown in Table 3.

2.3 Method

The main challenge in the production of the case studies was to ensure that the team of 19 investigators would undertake their research within tight deadlines, and present their research in a way that enabled cross-case study analysis. The solution was for the Observatory to develop a methodology for the production of the case studies and to apply some of the processes and management products of PRINCE 2.

The methodology and production process worked well, but a large amount of time was spent by the Observatory on chasing investigators to meet deadlines, and quality reviewing multiple revisions of the reports to make sure they were fit for purpose. By 20th December 2006, the end of the year, all the case studies had been approved by eWales as planned.

2.4 Reporting

To capture the change, impact and benefits of broadband for each case, 5 metrics form templates were created, to be used by each of the investigators. Each of the forms had tables to record interview notes in a structured way on the case situation, pre and post broadband. The forms gathered information on the impact broadband had made on: Internet Connections, Operational Tasks, Finance, Home Working, and Use of Internet Applications.

Each investigator was required to create the final Case Study Report from the content of two intermediate outputs: a Context Report and an Interview Report, which had to be quality approved by the Observatory.

The Context Report included secondary research to satisfy the contextual aims of the Product Description. A 2 - 3 page summary of that report made up the Context section in the Case Study Report.

The Interview Report captured the notes from the case research and summarised the information in the metrics tables. In many ways, it was a first draft for the major part of the final Case Study Report, but its main value to the Observatory was to facilitate an early quality review of the case investigation.

In the final Case Study Report, all data in the metrics table was summarised and presented, so that a net monthly Impact on Profit for each case could be calculated – see an example in Table 1. The structure of the document allowed the findings to be reported under the main headings of ‘Pre Broadband’, ‘Post Broadband’ and ‘Change Impact and Benefits of Broadband’.

MONTHLY FINANCIAL METRICS			
DESCRIPTION	**BEFORE Broadband**	**AFTER Broadband**	**IMPACT on Profit**
Cost of Internet Connection:	294 €	56 €	238 €
Home Working:	0 €	0 €	0 €
Employee Time on Tasks:	4,973 €	2,887 €	2,086 €
Operational Overheads:	5,404 €	4,318 €	1,086 €
Sales Revenue:	116,480 €	121,334 €	4,854 €
Direct Costs:	67,558 €	70,372 €	-2,814 €
TOTAL MONTHLY BENEFIT:			**5,450 €**

INTERNET CONNECTION CHANGES		
DESCRIPTION	**BEFORE Broadband**	**AFTER Broadband**
Internet Bandwidth:	56Kbps	512Kbps
Internet Users:	2	11

Table 1: Shows an example of the summary metrics for the Professional Sportswear Marketing Ltd case study www.bbwo.org.uk/pdf/BBWO-CS-20_PSM_Brian_Hogg_v1.0_approved.pdf.

3 Findings

The purpose of case study research is to test the validity of a proposition, by the gathering of evidence through research undertaken to answer the enquiry questions. Therefore, when analysing the Case Study Reports, trends and interesting observations identified across the case studies allow conclusions to be drawn. All 24 Case Study Reports may be accessed at www.bbwo.org.uk/casestudies.

In Table 3, below, a summary is presented, for each case, of some of the key metrics that were gathered, and the key observations pre and post implementation of broadband. An explanation of the fields and values in Table 3 are provided in the next section.

3.1 Explanation of the Fields and Values in Table 3

Place: Has three values: Urban, Semi-Urban and Rural. Its purpose is to give an idea of the type of location for the primary units of analysis.

Staff: States the number of employees, including the self-employed, and helps to give a feel of the size of the organisation.

More Users: Is the increase in the number of users accessing the Internet post implementation of broadband.

Change Impact Benefits: Uses numbers to indicate the main observed changes to activities or benefits as a result of the implementation of broadband – see Table 2 below for the number descriptions.

Number	Description for 'Change, Impact Benefits' column
1	Improvements in Customer Service or Support
2	Developing New Products and or Services
3	Increased use of eMarketing Methods
4	Entering New Markets
5	Extranet Implementation
6	Faster Production
7	Improved Administration Efficiency
8	Increased use of On-line Purchasing
9	Increased use of On-line Shopping
10	Increased on-line Submission of Government Returns
11	Increased use of Training
12	Increased use of eBanking
13	Increased use of eCommerce methods for Systems Integration and Trading
14	Increased Web Accessibility
15	Increased use of Internet Communication Methods e.g. email, VoIP, Video, etc
16	Intranet Implementation
17	Increased number of Large File Transfers
18	Lifestyle Improvements
19	Reduced Business Travel
20	Reduced Commuting Travel
21	Increased Tele or Home Working
22	Faster Web Site Updates

Table 2: In the 'Change Impact Benefits' column of Table 3, the string of numbers for each case indicates the main activities or benefits described in the Case Study Report.

Internet Connection: Provides the **Pre** and **Post** broadband bandwidth in Mbps for each primary unit of analysis, and the change in the cost of their Internet connection post broadband. Some of the cost values are negative, showing that it was more expensive to have broadband. A few of the bandwidth entries indicate multiple lines e.g. 0.056 *4 indicates 4 narrowband lines and the symbol 'S' indicates symmetric upload and download bandwidth, which applied to a leased fibre-optic ISDN line and a SDSL broadband connection.

Total Profit/Month: Gives an estimate of the **Impact on Profit/Month** achieved by implementing broadband that has resulted from easily identifiable and predictable operational changes.

3.2 Case Profile and Summary of Key Observations and Metrics

Profile Information				Change	Internet Connection			Total
Case	**Place**	**Staff**	**More Users**	**Impact Benefits**	**Pre Mbps**	**Post Mbps**	**Change /month**	**Profit /month**
Medium Sized (50-249 employees)								
Church in Wales	Urban	70	50	1, 7, 15, 16, 17, 19	0.056 0.128	5.5 1.0 S	-108 €	**2,035 €**
Wheelies Direct	Urban	70	35	1, 2, 3, 4, 13, 17, 22	0.056	8.0	-7 €	**4,123 €**
Small Sized (10-49 employees)								
Cantre Mobility	Semi-Urban	22	6	1, 5, 6, 13, 16, 19	0.128	6.5 5.5	70 €	**1,442 €**
Coast & Country	Rural	10	7	1, 3, 7,12, 13, 17, 22	0.128	8.0	56 €	**1,428 €**
NFU Cymru	Semi-Urban	15	0	1, 7, 17, 18, 20, 21	0.056 *4	1.0 *4	-56 €	**800 €**
PSM	Urban	16	8	1, 3, 4, 6, 12, 13, 17	0.056	0.512	238 €	**5,450 €**
Property People	Semi-Urban	16	14	1, 3, 13, 15, 17, 22	0.056 *5	1.0	210 €	**2,510 €**
Town & Country	Urban	40	17	2, 6, 10, 15, 17, 21	0.056	8.0	-28 €	**424 €**
TRAC	Semi-Urban	11	2	1, 3, 7, 11, 15, 17	0.056	2.0	-9 €	**413 €**
Micro Sized (1-9 employees)								
Barton Nichols	Semi-Urban	6	0	1, 6, 7, 8, 15, 17	0.056	2.0	-13 €	**435 €**

City Canteen	Urban	8	1	1, 2, 3, 7, 8, 15, 18	0.056	8.0	-8 €	**516 €**
Clippers (HG)	Rural	2	1	1, 8, 12, 13, 15, 22	0.056	2.0	-13 €	**351 €**
Joel Graphics	Rural	1	1	1, 2, 4, 6, 8, 9, 17	0.056	0.512	38 €	**1,280 €**
Jones Associates	Semi-Urban	3	4	1, 6, 7, 15, 16, 17	0.056	2.0	-4 €	**2,033 €**
Net-Work Internet	Rural	6	15	1, 2, 13, 15, 17, 18	0.128 S	6.0 *2	1,110 €	**1,110 €**
Punctum	Urban	5	2	1, 2, 6, 15, 17	0.056 *5	8.0	81 €	**1,291 €**
Red90	Rural	2	0	1, 2, 4, 6, 15, 17, 20	0.056	2	-20 €	**2,899 €**
Suite Options	Urban	6	3	1, 7, 8, 15,17, 22	0.056	2	28 €	**246 €**
SOHO (Home based)								
Cerion & Family	Rural	1	3	9, 15, 17, 18, 19	0.056	0.512	0 €	**655 €**
Colour Macs	Urban	1	0	1, 6, 15, 17, 18, 19	0.033	2	7 €	**2,786 €**
Druid Enterprises	Rural	1	0	6,15, 17, 18, 19, 21	0.056	0.512	189 €	**1,526 €**
JD Associates	Urban	2	0	1, 4, 6, 15, 17, 19	0.056	2	34 €	**4,343 €**
Orchard Davies	Urban	2	1	6, 10, 11, 14, 15, 17	0.128	8	21 €	**1,729 €**

Citizen								
Daniel Roche	Urban	-	0	9, 14, 15, 17, 18	0.056	2	14 €	**14 €**

Table 3: Presents a summary of the profile information and the main changes and benefits, with the key summary metrics for each of the 24 primary units of analysis.

Number	Description of Change, Impact and Benefits	Ranking
1	Improvements in Customer Service or Support	1
17	Increased number of Large File Transfers	2
15	Increased use of Internet Communication Methods e.g. email, VoIP, Video, etc. Web 2.0	3
6	Faster Production	4
2	Developing New Products and or Services	5
7	Improved Administration Efficiency	6
18	Lifestyle Improvements	6
3	Increased use of eMarketing Methods	8
13	Increased use of eCommerce methods for Systems Integration and Trading	8
4	Entering New Markets	10
8	Increased use of On-line Purchasing	10
19	Reduced Business Travel	10
22	Faster Web Site Updates	10

Table 4: Ranking of the top 10 main changes to activities or benefits observed across all 24 cases.

In Table 4, the high ranking of activities or benefits that are related to core operational areas and processes suggests that, for most of the cases, broadband has created new opportunities for increased productivity and efficiencies gains, which would not have been realised with narrowband.

4 Pre-Broadband Findings

The main message from the cases on their pre-broadband Internet experience was one of frustration at having to endure very slow data download and upload speeds coupled with time-outs and unexplained drop-outs. This applied to both analogue (usually 56Kbps) and ISDN (128Kbps) dial-up connections. Even Net-Works Internet Ltd, who had the expensive privilege of having a leased fibre-optic ISDN line with symmetric 128Kbps upload and download, said that they also experienced the same frustrations and desire for more bandwidth, in relation to their core business activities.

Although remarkable eCommerce activities and improvements in business processes have been achieved by early adopters of the Internet using narrowband, in the last few years it is evident that many of the cases were being constrained in

business growth or operational efficiency by not having broadband. Moreover, as can be seen in Table 3, the lack of broadband stifled the widespread and pervasive use of the Internet amongst staff, and across operational areas. It even stopped several of the businesses from creating new products and entering new markets. To illustrate the problems that a lack of broadband created for some of the cases a few extracts from the Case Study Reports are presented in the next section.

4.1 The Impact of Bandwidth Deprivation

Business Travel and Commuting: Many of the cases described situations where a lack of broadband would force them to travel frequently, usually by car, sometimes hundreds of kilometres to a customer site, in order to install software physically, undertake technical support, have business meetings, or get proofs approved. For Druid Enterprises, having a broadband connection was so essential to their work that the business owner would live in a bed and breakfast 20 days a month to access his client's broadband, away from home and his young family. On other occasions, he would make an 84 kilometre round-trip with a CD to use a broadband connection at a friend's house.

Large File Transfers: Those who struggled on with a narrowband connection to send large files of 0.5 MB or more would often encounter errors in transmission, time-outs or drop-outs, and have to start sending the file all over again. Many of the smaller businesses only had one telephone line and so would be constantly fretting about lost business opportunities due to having an engaged telephone line when using the Internet. Others knew that not having broadband made them look unprofessional as they continually had to check that clients had received an email with a large file attachment or wait a long time to receive one. Some cases incurred additional cost by using their mobile phone as an extra phone-line to talk to clients when on-line.

Collaborating with associates on large documents, and performing on-line testing of digital products, was also slow and tedious, due to lack of a fast Internet connection.

Updating Web sites was described by several cases as a very labour intensive activity, because it took so long to upload new content. On occasions additional costs would be incurred as a CD would have to be written with the copy and image file updates so that their Web developer could use his broadband connection to make the Web site changes.

Posting CDs would also be a common method of sending large files and videos that could more easily be sent over broadband.

Sending out paper-based catalogues and promotional literature was still the main method of communicating with customers when only narrowband was available.

eGovernment: The on-line filing of tax returns using a dial-up connection by accountancy firm Orchard Davies was thwart with problems due to errors in transmission even though they received a confirmation transmission log for each one. These errors would often result in fines, and considerable time on the telephone resolving the problems. "There was one instance where a submission of

40 files that I made was not received by the Inland Revenue. You can imagine the problems that this caused and the time spent sorting it out."

Internal and External Communications: Use of the Internet for researching the Web, and sending emails with attachments, was limited in organisations when only dial-up was available. Concerns over cost, engaged phone-lines, and a general lack of enthusiasm to use what tended to be a slow and unreliable method of communicating, did not motivate staff to switch away from telephone, fax, post and paper-based communications.

Lifestyle: In recent years, many Web sites have become image-heavy and content-rich, with multiple Flash/Shockwave-based and other multimedia content. This has meant that, with a dial-up connection, research on the Internet is very slow and some on-line shopping sites, like supermarket giant www.tesco.com, are just not practical to access. So lack of broadband was discouraging Internet home-users from shopping on-line and undertaking research on the Internet for school work and hobby-based activities. The wife of the sole trader at Joel Graphics gave up doing research on the Web to start her on-line business as with dial-up it was too slow to access the Web sites of potential competitors.

Web Accessibility: With a dial-up Internet connection, Daniel Roche, who is totally blind, made limited use of email and searching the net, as the phone line would be engaged when he was on-line, and he also needed to keep costs down. At that time, he was much more reliant on traditional radio and television broadcasts, audio-cassettes, and friends and family telling him what was going on.

Software Downloads: A common admission by many of the cases was that with narrowband they rarely, if ever, bothered to download anti-virus, firewall, or systems updates and so their PCs were often riddled with viruses, and were slow and error prone. Wheelies Direct Ltd had to request CDs and manually install updates on internal PCs as with dial-up there was insufficient bandwidth to download the large files – this task used to take IT support staff 20 hours per week.

5 Post Broadband Findings

Almost all the cases were desperate to get broadband, and were eagerly awaiting the enablement of their exchange as part of BT's roll-out or Welsh Assembly Government's RIBS programme. When the momentous day arrived for them to be connected to broadband, all the dial-up connectivity problems instantly disappeared; it was "a different world".

It was then that far-reaching changes could be made to operational areas of each organisation, resulting in faster production, cost savings, innovative new products, entering new markets, growth, and a positive impact on profit. Indeed, without broadband many businesses would not have been able to create new higher-value offerings for their customers, improve customer service, compete with larger or lower-cost national or international competitors, or would simply be too inefficient to be sustainable.

From Table 3, it is clear that 70% of all the cases were found to have increased the number of Internet users once they had broadband. However, the figures do not

tell the whole picture, as there are many broadband benefits that are intangible and difficult to quantify. Some were one-off, ad-hoc, or partially attributable to broadband and, therefore, were not included as impacting on profit, even though they did. For example:

Town and Country Broadcasting made large cost savings by submitting radio licence applications to Ofcom www.ofcom.org.uk on-line instead of in hardcopy, and this saved € 14,000 per application. A faster Internet connection also speeded up the market research time and reduced it from 4 days to 1 day.

Barton and Nichols were compelled by their two major customers, NFU Mutual www.nfumutual.co.uk and Lex Vehicle Leasing www.lvl.co.uk, to use an on-line insurance repair-estimating system called Inter-est www.inter-est.net, which needed broadband to access it. Turnaround of work pending approval has been reduced from 2 weeks to around 24 hours, as Image Insurance Engineers can now approve most work on-line, with digital photographs attached to the estimate submission. Other benefits are that filing and administration have improved, as paperwork for estimates are all held in the system, storage time of vehicles in the car park has been reduced, and payment is faster for completed jobs.

As the majority of repair work is now approved on-line this has cut down dramatically on the travelling time, expenses and carbon emissions of Insurance Engineers making on-site visits to approve work. Policy holders are also happier as their vehicles are being repaired much faster. If the company had not been able to get broadband it would have seriously jeopardised over € 462,000 of revenue, and their approved-supplier status.

ColourMacs Limited is a small home business offering a range of graphic design and printing services for the production of promotional literature and printed office stationary. Before broadband the General Manager and main income-earner used to spend the majority of his time during office hours travelling to and from clients, to take a brief, discuss and get approval for proofs, go to the printer, and deliver the finished printed material. This resulted in him spending far too much time on the road, travelling between 63,000 to 84,000 kilometres a year, and having to do most of his actual productive work outside of office hours.

This method of working had a huge impact on his lifestyle, having little time for his family and enjoyment: the stress of it took a major toll on his health. With broadband, he has cut out 35,000 kilometres of travelling a year, by using email to receive client instructions, send proofs, and receive approvals from clients, and finally send print-ready files to the printer – typical file sizes of attachments are 1.5 MB. The release of more productive time has enabled the business to generate an additional € 5,152 per month of revenue and save € 7,980 per year on travel expenses. It has also enabled the General Manager to adopt a much better life/work balance, reduce stress and enjoy better health.

Broadband has made it feasible for Jones Associates Limited, independent financial advisers, to keep up-to-date on market information, complete on-line applications, and enjoy the benefits of changing to an almost paperless office. The company chose Intelliflo www.intelliflo.com, a Web based back office system, to help them manage their clients effectively, transfer data between sellers, underwriters and themselves, and store confidential documentation centrally.

Real time valuations of a customer's portfolio are also now possible directly over the Web. Previously, this would have been done via numerous lengthy phone calls, which could take up to an hour.

In addition to the large savings by making on-line applications and administration, the turnaround of new business has been reduced from 4 weeks minimum to 1 to 2 weeks, which has also resulted in faster and higher commission payments. Overall, the impact on profit is estimated as an increase of € 2,032 per month.

Tredz www.tredz.co.uk is a new division of Wheelies Direct Limited, and offers a comprehensive eCatalogue for the on-line retail of bicycles and accessories, with over 5,000 products and their associated pictures. It is unlikely that the Web site would have existed with dial-up, as it is image-heavy and powered by a hosted content management system; it also requires a large number of frequent product updates. In addition, the on-line store and the two retail bicycle shops all access through the Internet 'cybertill' www.cybertill.co.uk - a fully integrated hosted EPoS system (to scan details of products and update stock control), eCommerce and Mail Order solution with a sophisticated CRM interface. All data is held on an external server; the Tredz team are able to access this system and, when required, order/reserve goods.

JD Associate Limited made little use of their dial-up connection, as the on-line experience was found to be slow and frustrating when undertaking Internet research. Since getting their broadband connection in 2005, the business has measured increased customer satisfaction, faster response to inquiries, and a richer quality of training materials. The Managing Director has also reduced his business travel by 12,600 kilometres per year, as he is now more often able to deliver training and education presentations remotely. However, it is the broadband developments across Europe, Asia and Africa that have allowed the business to access markets previously thought to be inaccessible.

A recent example of this was the delivery of an on-line module for an MBA programme based in Dubai, UAE, with 24 students from the Middle East, Europe and America, using the Interwise www.interwise.com on-line conferencing and Blackboard www.blackboard.com virtual learning environment. As bandwidth in India and Pakistan are upgraded in 2007, it is hoped that this will enable new markets to be exploited.

Net-work Internet Limited is a micro business, located in a rural area of North Wales, offering ISP and network management to local and national clients. When their exchange was ADSL enabled, the business replaced its leased ISDN line with two 6 Mbps ADSL lines with 2:1 contention ratios, resulting in a 95% reduction in telecommunication cost. The main benefit for the company was, however, that they were now able to make file transfers of more than 10GB to manage their co-located servers in London and Washington, DC, and take proactive real-time network management of the Internet connections used by their ISP customers. They are also developing Web based 'Software as a Service' applications for small businesses.

5.1 General Broadband Usage

All the cases reported an increased use of, and dependence on, email for internal and external communications and less use of the telephone, fax and paper-based correspondence, including catalogues. This has resulted in the strengthening of networking relationships with partner organisations, and more responsive customer service and support. What was also impressive was that many of the organisations were naturally innovating, and changing their processes from laborious paper-based administration, marketing or sales, to using hosted eCatalogues, content and document management systems, and integrated stock and maintenance management systems. Some of these applications used to be the preserve of only larger corporations.

Broadband made it possible for many entrepreneurs to locate their businesses at home, often in very rural areas, and reduce their overheads; a reliable broadband Internet connection made the need for having a formal office setting to meet clients unnecessary.

For people who are blind or partially sighted, having access to broadband is becoming far more than just a luxury. It is fast becoming a necessity, as it is the only means by which they have regular and reliable access to basic communications and information. By using a screen reader, Daniel Roche can 'read' the daily newspapers, newsletters from Web sites relating to his hobbies (www.topgear.com) and (www.telegraph.co.uk) for the motoring section. Prior to broadband, delivery of these publications was possible, but was time-consuming and frequently seemed to go wrong when downloading, due to the large file sizes. "As a screen reader user, broadband has made things so much easier… I am able to participate in using the Internet like anyone else now and I'm really enjoying it!"

6 Conclusions

All of the cases have changed the way they operate to embrace broadband Internet communications. Narrowband connections did not motivate many of them to adopt new and more efficient ways of working, or of communicating with their customers and other stakeholders. Some used broadband as the enabler to integrate their eCommerce systems with their back office applications, or to provide remote offices and home workers access to intranets, and other stakeholders to extranets.

In several cases, maintaining a competitive advantage because of changes in the marketing environment, or operating in a sustainable way, could only be achieved by leveraging the power of a high-speed Internet connection – narrowband simply would not do.

It is very encouraging to see many of the micro and even SOHO businesses orienting their operations around Web based, hosted, or on-demand software as a service applications, and achieving huge administrative efficiencies and productivity gains. It is noticeable that for many of the cases their major customers actively encouraged or even insisted that they engage with them through an extranet or Web based applications, which needed broadband.

Broadband has enriched the life of the citizens and families included in the cases and encouraged them to use the Internet for on-line shopping, personal research, socialising, and keeping more informed. Two of the cases interviewed people who were either blind or partially sighted, and both said broadband had made using the Web much more accessible and offered lifestyle benefits.

Many manual paper-based processes have been reduced or eradicated by using affordable hosted applications or Internet communications. Tens of thousands of kilometres and large volumes of CO_2 emissions have been saved by reduced business travel and commuting as a result of broadband availability.

In a few short years or less since getting broadband, the cases are now, without doubt, dependant on broadband and would suffer massively if they were to lose their connection, or if it were to become in any way unreliable, or lose its high-speed capacity. The dependency on broadband and the demand for higher-speed connections are also likely to increase as many of the cases are actively planning to introduce business quality VoIP systems and publish richer, bandwidth-hungry content on their Web sites.

The increased availability and adoption of first generation broadband has indeed resulted in change, impact and benefits for businesses, organisations and citizens in Wales. However, it has also greatly increased their dependency on broadband and the need for even higher-speed Internet connections in the future. The importance of this message has been developed further by the recent report 'Pipe Dreams?' by the Broadband Stakeholder Group, which addresses the implications of the continuing growth in the "underlying demand for greater bandwidth" on the UK's telecommunications infrastructure and the need for "investment in next generation access networks".

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