

Compagnia

Collaboration software in the construction industry.

June 2003

Introduction

Collaboration software encompasses intranets, extranets, enterprise portals, knowledge management applications; this report focuses on collaboration software in the context of project extranets, and has been compiled on the basis of data gathered from all the major UK users and suppliers of collaboration software.

Collaboration software has now reached a level of maturity that enables us to establish meaningful data, together with predictions based on relevant information accrued over the past 5 years.

Compagnia would like to thank the large number of organisations who participated in this research; without which it would not have been possible to accurately determine the benefits of collaboration software.

In particular, we would like to mention:

Accenture, Alstom, Amec, Arup, Aconex, Babbie, Balfour Beatty, Ballast, Benoy, Bidcom, Bilfinger Berger, Birse, BIW Technologies, Bovis Lend Lease, Build Online, Business Collaborator, Cadweb, Charrington, Carillion, Causeway Technologies, Costain, CPG, EC Harris, EPC Integration, Exxon Mobile, Fitzpatrick, Galliford Try, Halcrow, Halliburton, HBG, Highways Agency, IKEA, Intergulf, John Lewis Partnership, Kajima, Kier, KSIG, Mansell, Metronet, McDonalds, Mott McDonald, Mowlem, National Grid, Nationwide Building Society, Network Rail, Norwest Holst, OFB, Peabody Trust, P & O Developments, Pearce Group, Prudential, MOD, Royal Bank of Scotland, Sainsbury's, Sarcophagus, Sir Robert McAlpine, Six Continents, SolidBau, Southern Water, Strafbag, Symonds Group, Taylor Woodrow, Thames Water, Transco, Transport for London, Waitrose, Wates, Whitbread, Wilson Bowden, WS Atkins, 4 Projects.

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Executive Summary

Collaboration software compliments, but does not replace, traditional methods of communication; it is about reducing administrative burden and improving communication.

The construction industry has low productivity, some estimates are that almost half of the effort produced by its people is non-productive, which implies that there is also vast inefficiency in asset utilisation. Construction has the lowest research and development of any business sector which when combined with the challenges that face the industry indicates that there is much we can do to improve productivity.

We therefore need to find ways to improve productivity and a part of the jig saw is provided by the effective use of IT, of which collaboration software – which provides a project centric perspective and engenders enhanced teamwork – is a fundamental part.

The measurable savings achieved from the proper deployment of collaboration software comprise an average 1.28% (% of annual revenue or turnover) of measurable direct savings, together with an estimated minimum 3% from measurable consequential benefits. Purely qualitative benefits accrue through improved communication and time efficiency and although many of these are impossible to quantify and assign to collaboration software, their impact is substantial.

The adoption of collaboration software throughout the construction industry could reduce costs by at least 4.28%, enabling us to build an additional 5 hospitals and 3000 homes per annum without increasing the UK's overall annual construction expenditure of £ 69 Billion.

The conclusion of this report is that collaboration software leads to significant organisational improvements due to the collaborative processes that evolve. The implementation of collaboration software is not without its risks, but the potential to provide tremendous benefit far outweigh the risks.

The savings will take time to work through the system as a benefit to clients, and we expect this process to vary from a few months in some cases (“quick wins”) to a number of years where there are deeply embedded market and cultural issues.

The vast majority of European business executives believe that those businesses that react quickly to changing business models, technologies and processes will outperform those that concentrate on cost-cutting.

1/ Review of collaboration software

1.1/ Definition of collaboration software

Collaboration software enables organisations to centralise electronic documents, thus allowing users from a number of different organisations to work in a more collaborative fashion. The primary objective is to move away from traditional sequential paper-based systems, thereby breaking down barriers to communication.

New business benefits derived from the use of collaboration software include:

Immediacy - send an electronic document to a website and it is immediately available for viewing; likewise, written feedback is available without delay.

Community - the cost of forming project groups (and or groups of common interest) is reduced significantly; increased communication increases trust, which can lead to increased innovation.

Connectivity - potential for interoperability with business applications provides near-term project- (or mission-) based perspective.

Transparency - alignment of business processes increases transparency as barriers to communication are removed; users' actions on the collaboration system are recorded for audit purposes. Collaborative systems reduce the amount of re-work by storing not just information but the knowledge that derived it.

In the construction industry, there are typically 50 to 250 organisations involved with the execution of building contracts, (construction professionals, contractors, specialist contractors, suppliers, statutory authorities, health and safety, highways agencies etc).

Traditional paper based administrative systems mean that for every document issued, there is need to copy (sometimes in part, sometimes whole) and pass “down” the supply chain sometimes for information, sometimes for comment and return and usually in accordance with some level of contractual obligation. Time is money and cumbersome processes extract sizeable hidden costs that organisations become blind to – our findings confirm that the budget for collaboration software is built in to the price of these hidden costs.

Bearing in mind the number of organisations in a typical project supply chain, this creates two major problems, (1) the system is inherently challenging in terms of effective communication and (2) the administrative burden is tedious and expensive. Ineffective communication and poor administration lead to bad management.

The essence of collaboration software is to develop a process whereby documents are all electronic, thus enabling them to be located at a secure central location that can be accessed by those to whom access rights have been given while maintaining business processes, supply chain relationships and organisational hierarchies - see Figure 1.

Compagnia’s specification for Collaboration software (construction industry context):

Functionality

- 1/ Easy to use intuitive interface that minimises training and business disruption.
- 2/ Close alignment with established and evolving business processes. This should include functionality that enables users to adapt the system to suit their processes where necessary.
- 3/ Must lead to the acceleration of knowledge transmission, i.e. not just be limited to optimising project document transmission.

4/ Real-time management reports to allow the project team to manage the use of the system including, for example, how many actions are outstanding.

5/ Includes design, procurement, operations and asset maintenance functionality.

6/ Enables document transmittals to be conveyed in accordance with contractual obligations, and in a timely manner.

7/ Searching should include high quality free text capability, with customisable search options.

8/ Workflow should be assessed critically in terms of its value to the business, which can be limited where there are participants from external organisations that have different business processes. Workflow can be a benefit to simple processes that do not alter significantly.

9/ Minimal need for meta-data input.

10/ Customisable reports (which can be saved on the system) are highly beneficial, and reduce the time taken to extract information.

11/ E-Mail interaction with the system is critical, ensure that this works to suit the company's preferred processes and therefore avoid barriers to use.

Technology

12/ Secure access control at the folder, document and business process form level to ensure users' access rights are in accordance with their role and hierarchical level.

13/ Users to be able to view, download, print and plot documents without the need to purchase software applications that the documents were produced in.

14/ The system must be accessible from any computer and suitable mobile device with internet access, from anywhere in the world at any time of day.

15/ Comprehensive and wholly reliable audit trail that records each and every action taken by users at every level.

16/ Open architecture, including XML, ODBC & web services capability.

17/ Multiple uploading of documents.

18/ Systems should make allowances for use across low speed connections.

19/ Ability to capture fax and e-mail documents.

20/ Interoperability with other collaboration systems.

21/ Low cost of integration with ERP and other business applications.

Commercial

22/ The number of users (of the supplier's system) is important, this indicates not only the financial viability of the supplier, but points to the system's network effect whereby a large number of users ensure system optimisation (through user groups, feedback etc) which leads to an increase in users and so on.

23/ The system and related costs must be below the measurable direct savings.

24/ The system should be available either as an ASP or on a licensed basis and customers must have the option to operate without supplier dependence.

25/ When the project is complete, the system should output the data in a format that has an appropriate user interface and includes functionality that includes document and free-text search. The output should either be to a dedicated website or to a CD/ DVD.

26/ Users should be pragmatic about how collaboration systems are used when there is a contractual dispute, resulting for example in a claim, contracts should make provision to ensure transparency is maintained, which may include taking a snap-shot of the system.

27/ High quality help-desk and support, including data recovery.

28/ Watch for maintenance fees and other add-ons.

29/ Compare hosting fees with those available at data centres where appropriate.

30/ Read the small print and, where necessary, seek advice from specialist IT lawyers.

32/ Define the criteria against which service delivery is measured.

33/ Access to specialist developers - make sure that availability and cost are established.

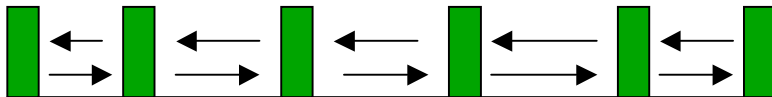
34/ Ensure that the supplier is of sound financial standing, check credit ratings and obtain transparent, up to date, financials. If part of a group, expect to see a parent company guarantee.

35/ Agree the contractual position relative to document control with the supply chain, with special attention to documents not automatically captured by the system.

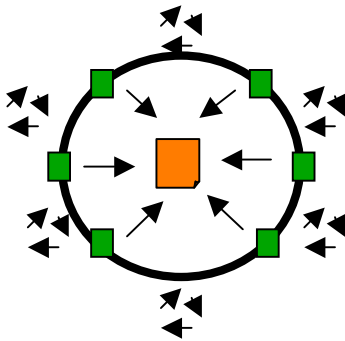
36/ Organisations will tend to want to retain their own document control for commercial purposes, this issue should be discussed early on to ensure that document schedules are mapped to ensure continuous alignment.

37/ Adequate training is critical to ensure success, ensure that all participants are trained and that the costs are included in commercial negotiations.

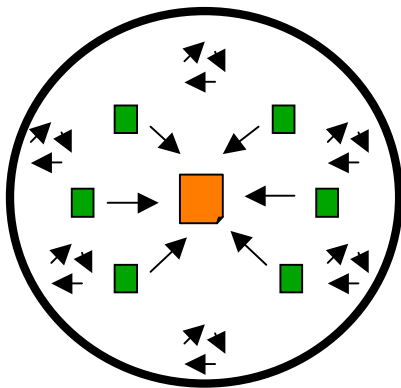
38/ Check supplier's dependency on third party software, establish breakdown of license fees.



Traditional sequential process – barriers to communication, low supply chain transparency



Collaborative processes centralise and streamline processes; communication improves as transparency creates an environment of trust.



As trust increases through improved communication, the collaborative sphere of influence increases to encompass more supply chain knowledge.

Figure 1 – the evolution of supply chain transparency

1.2/ User report summary

The results obtained represent feedback from over 70% of those responsible for having made decisions relative to collaboration software in the construction industry. What was immediately apparent was that all users were positive about the benefits.

We obtained over 70 responses from senior management and 35 from construction industry IT professionals. Scoring was from 1 to 10 (1 being poor, 10 being excellent).

1.2.1/ When we asked construction industry users “To what extent does the collaboration software system provide your organisation with operational benefits” their mean average response was 8.48.

1.2.2/ Our survey showed that 91% of respondents believed that collaboration software provides their organisation with significant financial benefits, albeit that it was considered difficult to establish an actual quantifiable benefit. They all said that collaboration software provides viable benefit.

1.2.3/ Users indicate that the flexibility of processes provided by collaboration software was generally acceptable, but that there was a need in all cases for an improvement of around 22%. User groups were generally regarded as the best means to refine functionality.

1.2.4/ Client and supply chain relationships are considerably improved when collaboration software is used, so said 74% of respondents. The remainder indicated that there was most certainly an improvement.

1.2.5/ Suppliers of collaboration software were all highly recommended by their clients, the scoring relative to “to what extent would you recommend the use of the collaboration system” was an average of 8.96.

1.2.6/ The question “to what extent does the collaboration system you are using align with company processes” was put to users, they responded with an average of 8.04.

1.2.7/ Users said that communication and innovation certainly improved due to the introduction of collaborative processes associated with the adoption of collaboration software, and a variety of reasons were given.

The feedback from users led us to conclude that collaborative processes generate a series of changes - Figure 2.

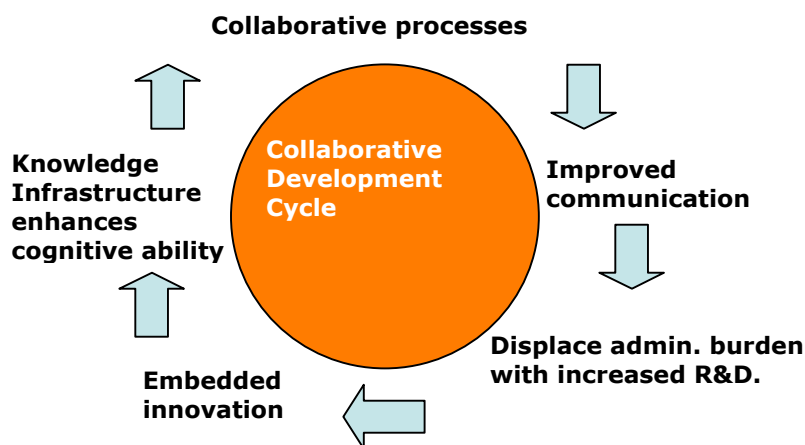


Figure 2

Collaboration software enables collaborative processes, which improve communication and reduce administrative burden. The resultant potential increase in innovation leads to more intelligent organisations that naturally work in a consistently collaborative process – hence the perpetual development cycle.

1.3/ Conditions required for a successful I.T. implementation

People:

- 1/ Learn from peers; do not reinvent the wheel.
- 2/ Learn whilst doing, make time to reflect
- 3/ Learn after doing; ensure retrospective analysis.
- 4/ Choose the right people to lead the initiative, using external resources where necessary but without creating long term dependencies.
- 5/ Use networking and develop communities of practice
- 6/ Avoid lack of consideration at board level, and ensure management accountability for IT-spend.
- 7/ Determine users' needs, and avoid "scope creep", the IT version of variations that occur during construction projects.
- 8/ An organisation's users must be IT literate, including, for example, being able to use Microsoft word and excel.
- 9/ Ongoing training and user feedback are essential.
- 10/ There must be sufficient "buy in" from participants.
- 11/ Set realistic expectations, and remember that changing people is the most difficult part of all. Expectations should include clearly defined goals.
- 12/ Ensure users make use of the system's functionality, and that their approach to it is truly collaborative, e.g. that they make use of the discussion forums.
- 13/ Ensure there are no new barriers to work as a result of the system.
- 14/ Apply an incremental, planned approach to making use of system functionality – be aware of the rate of change and the rate at which it can be absorbed.

Process:

15/ Develop a clear IT strategy, and build in new applications around the strategy, do not support initiatives that compromise the strategy unless it is considered that the new opportunity itself should cause the strategy to alter.

16/ Keep strategy up to date by keeping a close eye on technological trends and developments.

17/ Avoid renegade IT acquisitions outside IT budget.

18/ IT procurement procedures are often bureaucratic and therefore a drain on resources, make use of existing knowledge to avoid these (often understated) costs.

19/ Don't try to get around license fees – it will only bite back.

20/ Ensure the decision-making environment is right.

21/ Management should ensure that the system is properly managed.

22/ Systems should be piloted first and rolled out once the gremlins have been sorted. Do not select a system and immediately impose it on an organisation.

23/ Agree operational protocols, and bind into contractual obligations.

24/ Tackle the harder bits first; leave the buffer time at the end.

25/ Be aware of the phasing or sequencing of implementations, and ensure that the priorities meet the needs of the user, not of the IT team.

26/ Encourage people not to print documents!

27/ Ensure that functionality is used to maximum advantage – avoid lazy habits.

Technology:

28/ Don't have overlapping systems

29/ Make incremental changes; don't expect to change everything overnight.

30/ Organisations must establish an appropriate method of maintaining security to protect their own IT environment

31/ Specify business processes and map to workflow where appropriate.

32/ Consider interoperability/ integration issues in detail

33/ Ensure the project is process led, not IT led!

34/ Establish supplier's future strategy; assess how realistic it is and establish past track record relative to achieving release targets.

1.4/ Benefits of using collaboration software

We have not chosen to focus on how benefits are distributed in the supply chain, as ultimately these accrue to the client, nor are we concerned about who pays for the software and services, we assert that clients should work with their supply chain to ensure that the right collaboration software supplier is engaged and is then managed to ensure the benefits are crystallised for all project participants.

The figures quoted in this section (and the related appendices) are an aggregate assessment of the benefits obtained by users of collaboration software.

We believe that organisations must take a long term perspective and ensure that future project teams can benefit from the information learned – not only tacit knowledge but explicit knowledge (for example surveys, reports etc) that is so often lost.

The management objectives that provide the motivation to apply new processes and software can be broken into 4 types:

Cost reduction

Better information

Shared infrastructure and potentially with it shared (aligned) processes

Competitive Advantage

Collaboration software provides a range of benefits that address all of the above issues, implying that it has a high priority when benchmarked against other IT initiatives. (See Table 1).

I.T. is moving towards Integrated Knowledge Infrastructure, whereby knowledge becomes portable and low cost, and therefore business information becomes truly transparent.

Collaboration software is a fundamental component of Integrated Knowledge Infrastructure.

Collaboration software - Benefits Summary

OBJECTIVE	Immediacy	Connectivity	Transparency	Community
Cost reduction	Decision-making now based on near-term events.	Alignment of business processes throughout supply chain creates savings that ultimately accrue to clients. Appendix 6.2 indicates these saving to be 1.28% of project value. (Users confirmed that increased connectivity also enabled people to work more flexible hours and in some cases (e.g. night work) this lead to direct measurable savings of up to 2% of the project value).	A series of benefits accrue – see appendix 6.3 for details. Cost benefit range estimated to be between 3 and 6% The amount of re-work is substantially reduced, and although we were unable to extract a measurable benefit we estimate that between 5 and 15% of the work undertaken by knowledge workers in the construction industry is re-work that has been lost due to inefficient administrative systems.	Users stated that collaborative systems did create an improved sense of project community, and that as a result, communication between team members improved. Although difficult to quantify, the cost of transmitting information was reduced following the implementation of collaboration software. Improved communication led to an improved understanding of the needs of others, generating trust.
Better Information	Improved access to information creates more time for productive work. When we assessed the breakdown of (1) Gathering information, (2) Reviewing information and (3) Taking action, it was clear that we are all used to working in ways that are non-productive. See Figure 3.	There are numerous communication barriers – and many of them are left completely unnoticed. Users said that the barriers to communication were reduced by access to a managed, audited, central repository of information.	Reduced alteration by “messaging” implies that decisions can be based on more accurate information. It is much easier to tease out tacit knowledge when there is a collaboration system in place.	Forums populated by people of like-minded interest provided an environment more conducive to transferring knowledge.
Shared infrastructure	Business process alignment provides the foundation for “process networks”, i.e. operational procedures shared right across an entire industry. This will clearly lead to less administrative burden, and it will (over the medium term) radically alter organisational structures.			
Competitive Advantage	According to users, collaborative processes improve client relationships and therefore provide competitive advantage. Competitive advantage also accrues from cost reductions and reduced operational risk associated with improved communication.			
SUMMARY	We estimate that collaboration software leads to measurable cost reduction of approximately 4_% of revenue. This is a substantial figure, but it reflects the extent to which, over the past 300 years, we have developed non-productive systems that can now be streamlined through the use of internet technologies. The next 5 to 10 years will see the eradication of most if not all non-productive administrative processes.			

Table 1: Collaboration software - Benefits Summary

The Integrated Knowledge Infrastructure enabled by collaboration software substantially reduces the amount of non-productive work – this is a huge benefit to business – see Figure 3 below.

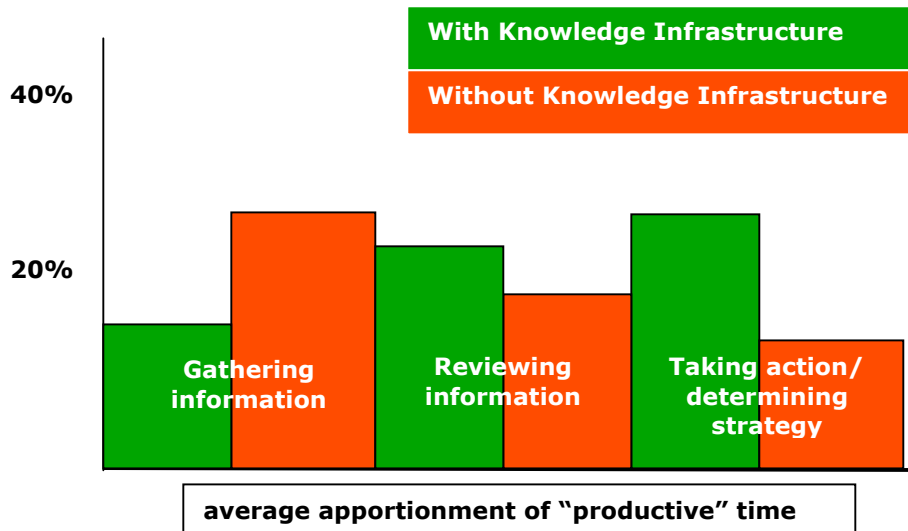


Figure 3: optimising time.

Work studies show that people spend up to 24% of their “productive” time gathering information, 19% reviewing information and the average balance of 16% taking some form of action. This is due to the inherently inefficient working practices that have evolved in order to administrate business.

Communication enables groups of people to achieve objectives they could not achieve alone, yet businesses often fail to recognise how critical effective communication is.

Gathering information: easy access to documents reduces time spent gathering information, freeing resources for more productive activity.

Reviewing information: improved access to peers, streamlining business processes and

Taking action: Reducing non-productive burden increases the amount of the most productive activity of all - thinking time!

1.5/ Cost – benefit analysis

The rental costs (or license fees) of collaboration software equate to approximately 0.2% to 1.0% of turnover subject to negotiation and whether software is used as a one-off for a project, or across multiple projects. The latter is generally referred to as an “enterprise” deal.

There is a huge “economies of scale” factor although collaboration software is a viable investment for all project scales because it demonstrably reduces costs.

To put this into perspective, expect to pay anything from £20,000 to £60,000 for a notional £10,000,000 project or from £5,000 to £10,000 for a £1m project.

Enterprise deals involve a considerable reduction and involve the use of the system (on whatever basis) for all or most of users’ projects, the user being anything from a construction client, to a project manager, main contractor. Enterprise deals are generally available at 0.2% to 0.6% on revenue.

In properly assessing the cost, users need to take account of ongoing training, related IT costs, participation in user groups, and system management. From data issued by users, we believe that these costs add a further 0.15% on project costs.

The cost range is therefore 0.35% to 1.15%, which compares favourably with our analysis of measurable direct savings of 1.28%, added to which are measurable consequential benefits that approximate to minimum of 3%.

Figure 5 indicates that there is a divergence between (a) the reduction in measurable direct savings and (b) total system cost as turnover increases, with most deals being on an enterprise basis, i.e. aggregated turnover.

In addition, our analysis confirms that as project risk increases in accordance with project scale (including design risk, construction risk, financial risk, and other consequential risks) both

measurable consequential benefits and pure qualitative benefits increase with project scale as the need for high quality communication becomes critical.

This further divergence between aggregate benefit and cost is a compelling argument for the adoption of collaboration software.

Summary of divergence between benefits and cost as project scale increases.

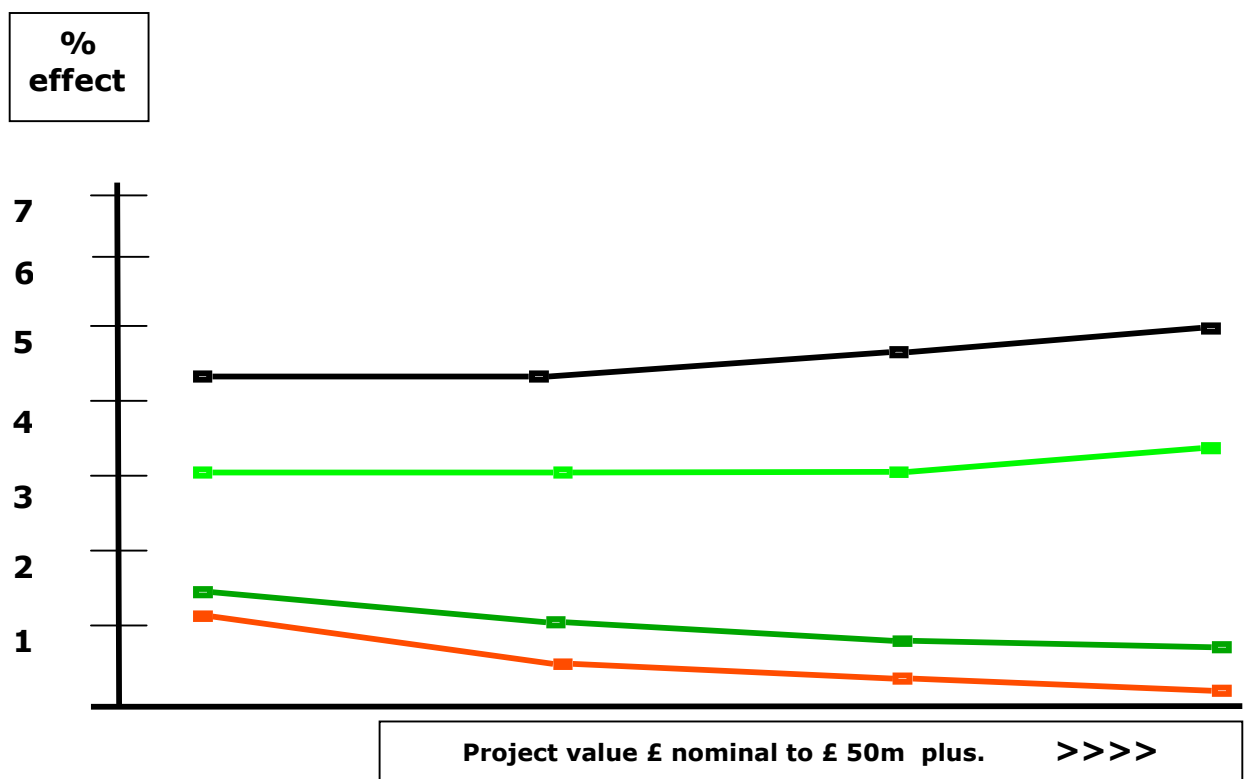


Figure 4 – source: user and supplier data

Red = total system cost
Light green = measurable direct savings
Dark green = measurable consequential benefits
Black = total quantifiable savings

1.6/ Examples of user data points (in all there were 241)

Microsoft's Xbox game was developed in record time by using collaboration software that aligned the design processes of over 200 suppliers; consequently the development cycle was reduced by several months leading to cost savings in the region of \$20million!

Bombardier's construction director summed up his views after using the 4 Projects system: "We knew it was a very hard programme to meet which we could not have achieved without the collaborative solution provided by 4Projects.com. Once you've used a system like this, it's hard to imagine planning a major project without it again."

Bechtel credit Bidcom with "significantly reducing project risk, shortening cycle times and reducing the overall cost of projects".

Build Online's system, according to German developer Odebrecht, has lead to savings of US\$ 5,000 per month on reduced document transmittal and printing costs alone. Other savings included reduced software acquisition costs to support viewing of the various document types used on the project.

WS Atkins state that the use of Business Collaborator as a knowledge management, intranet, content management and project extranet tool has reduced their costs by a much needed £2m PA.

Heery saved £25k in printing costs and £5k in storage costs on a project of unspecified scale. They were using the 4 Projects system.

Six Continents saved £17k on reduced office space through the deployment of 4 Projects' system. They also indicated that they saved £1500 per project by reusing surveys.

Mott McDonald managed to avoid the use of email on a project in Iceland, which enabled them to communicate rather better – thankfully reducing the number of site meetings.

Whitbread say that collaboration software reduces each and every site meeting cost by approximately £500; but they didn't mention where the site meetings were held!

Railtrack's nightshift engineers are now able to access information; they say that this leads to considerable reductions in non-productive time and rented sleeping bags.

Gleeds reduced copying and postage costs by £58k on a £5m project.

Kajima reduced printing fees by £12k, and design fees by £31k on a £8m project. (Savings achieved through the use of BIW's system).

Gleeds say that collaboration systems can facilitate project acceleration by 5%. (Savings achieved through the use of BIW's system).

Victorian State Authority said that they saved Aus\$ 544K on a 2 year project by using Aconex.

BAA calculated that on a 3 year project alone, they could save 2500 man hours relative to document management.

Lend Lease Bovis undertook probably the first detailed analysis of collaboration software when it was applied to the Bluewater retail project; they concluded that there were time and cost savings for all project participants.

Transco say that Build Online's collaborative procurement system reduces the cost of tendering by 20%; they also pointed out that the system assists them in achieving their environmental policy targets.

An independently verified survey by Intergraph showed that £10m spent on ensuring safety at a plant following a gas leak was due to as built drawings not being available!

A global oil and gas corporation spent £1m re-gathering as-built documents before it could redesign an existing plant; the same company found that 85% of the information in data sheets was inaccurate due to poor compilation.

StratOil say that the use of collaboration software has reduced their project development costs by 10 to 20% on £5 billion projects in Norway and the North Sea.

1.7/ Processes – design, procure, finance, build (manufacture), and operate

Whatever the business process, collaboration provides benefit because it centralises documents and improves communication between project team members.

Business processes interface with external organisations and therefore involve a constant flow of information. Prior to internet technology, most systems were completely isolated and consequently business culture was inward looking – the approach was to produce information in response to an external request and then send it on and wait for subsequent responses. Supply chain transparency was low, and business was excessively burdened with re-work and other expensive inefficiencies.

Internet technology and the connectivity it brings is turning business culture inside out so that organisations are becoming more externalised in their thinking as they become increasingly conscience of the benefits of transparency – as these benefits accrue, clients will begin to demand more transparency from their supply chain.

Organisations are compelled by market pressures to align with trends or loose out to more adaptive competitors.

Collaboration systems in the construction industry focus primarily on project management processes, and secondarily on procurement processes.

The maximum value of collaborative processes occurs when collaboration encompasses all business processes (see Figure 5) which are then integrated as a mission-based perspective of the organisation, with the organisation's processes aligned with its supply chain.

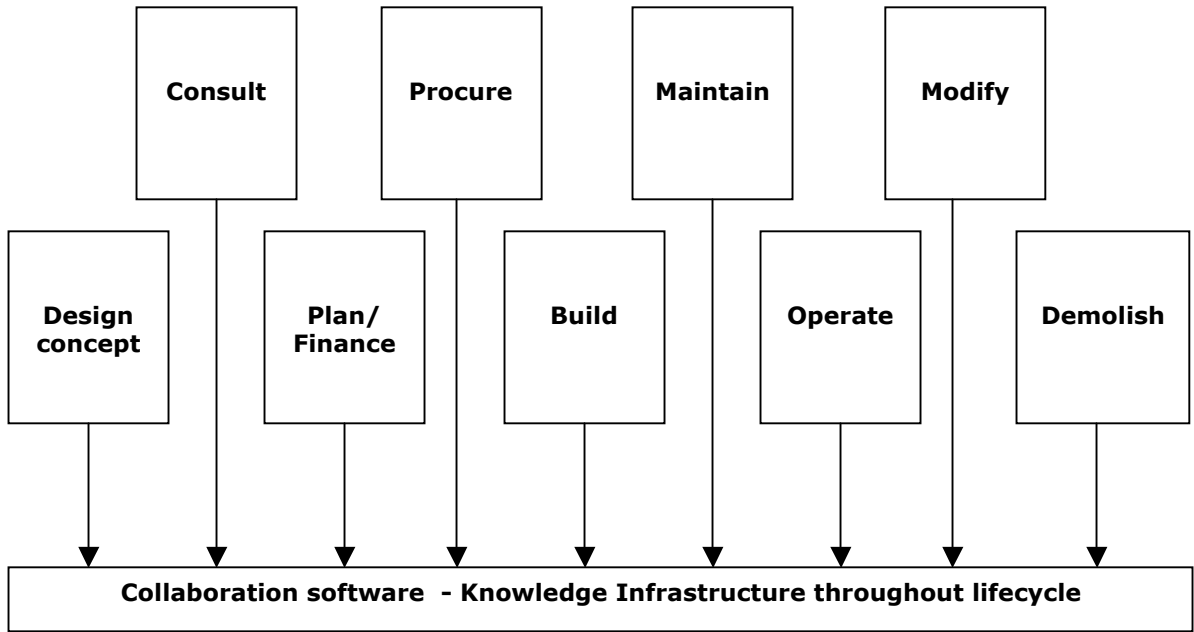


Figure 5 – maximised use of collaboration software

1.8/ Towards Integrated Knowledge Infrastructure

Integrated Knowledge Infrastructure enables organisations to capture and convey explicit and tacit knowledge at low cost; the unification of knowledge blends creative design, craft and technical skills to produce a higher dimension of thinking.

Integrated Knowledge Infrastructure enables people and organisations to capture and convey explicit and tacit knowledge provided:

a/ There are open standards that ultimately lead to adequate interoperability between business applications (ERP, CRM) and communication applications (E-mail).

b/ A collaboration system is in use.

c/ The processes comply with conventional hierarchical business structure.

d/ There is no dependence on government (unlike transport and telephone infrastructures).

e/ Computer-related utility continues to grow in inverse proportion to computer hardware and software costs.

These key points will take some to resolve, but we are heading down the road to interoperability so the question is not “if”, but “when”.

Integrated Knowledge Infrastructure is a transforming technology because it provides both (a) new utility and (b) structural change to traditional processes and technologies, for example:

a/ Rapid, cost effective formation of communities of common interest.

b/ Access to knowledge from anywhere, at anytime.

c/ Considerable reduction in administrative burden.

d/ Nominal cost of exchanging knowledge – we estimate that knowledge will reduce in cost by up to 50% per annum for the next 10 to 15 years.

e/ Human-machine interaction is a fundamental aspect of Integrated Knowledge Infrastructure; in the same way that painted caves captured and conveyed information to humans 30,000 years ago (supplementing the information that could be stored within the brain and extending the capacity for creative thinking), Integrated Knowledge Infrastructure has the capacity to capture and convey highly complex information and thereby further increase our capacity to think.

1.9/ Supplier summary

Name	Users	People	Ratio U:P	Market Share	Client scoring	PM	P	KM
Aconex	5,000 in Aus	18	277	N/A	7.6: applies only to Australia	Y	Y	N
Bidcom	6,000	10	600	6.8%	7.0: excluded large operation in USA	Y	Y	N
BIW	23,000	36	639	26.4%	8.5: largest user group	Y	N	N
Build Online	10,000	37	270	11.5%	7.1: majority of response from one user	Y	Y	N
Business Col	15,000	22	681	17.2%	8.7: highest client scoring (results include all aspects of collaboration software.	Y	Y	Y
Cadweb	6,000	15	400	6.8%	6.8: lowest client scoring	Y	N	N
Causeway	7,000	15	470	8.0%	7.1: includes references relative to US projects	Y	N	N
Sarcophagus	7,200	16	450	8.2%	7.9: the most consistent scoring from users	Y	Y	N
4 Projects	13,000	25	520	14.9%	8.3: highest user recommendation score	Y	Y	N
UK only:								
Totals/ Averages	87,500	194	475	100%	7.6: Average			

Table 2 - Supplier Summary

Table notes:

1/ PM refers to project management functionality, P is procurement functionality and KM refers to generic knowledge management, which, in the case of Business Collaborator, includes using the software to provide enterprise portals.

2/ The number of users is a critical component in evaluating collaboration software, as the number of good client relationships increases the chance of winning more clients leading to a further increase in the user group – in other words the number of users won over a period of time provides the value of the network effect, albeit varied by marketing expenditure, sales resource and how long the operation has been established.

3/ Client scoring was from an average of 10 client references per supplier.

3/ The Aconex data related to Australasia, so we could not put a value on their offering as it currently has nominal UK market share.

Suppliers indicate the aggregate number of users in the UK is 87,500, albeit that a number are people who use more than one system. It was not possible to determine a figure for the number of people using collaboration systems in the UK.

There are 194 people employed in the collaboration software business in the UK, which gives an average of 475 users per employee and annual productivity (see section 3.1) of approximately £ 47K per employee. These figures indicate that the sector is somewhat over-burdened with cost and likely to continue to consolidate despite the potential for increased annual revenue.

The high average “client scoring” of 7.6 demonstrates not only the value added by these suppliers, it also provides compelling evidence of the benefits attributable to collaboration software.

The three types of solution offered are:

1/ Tool-kit collaboration, to enable organisations to fit the software around their business processes. (Business Collaborator) While this has the advantage of flexibility it does involve more work on behalf of users to develop functionality.

2/ Prime collaboration software, offering a collaborative template that attempts to streamline the business processes associated with project management. (BIW Technologies, Cadweb, Livelink). These systems have hard-wired processes.

3/ Collaboration software that combines procurement/tender management with project management. (Build Online, 4 Projects, Aconex, Sarcophagus). These systems have hard wired processes that integrate project management with procurement.

Solutions are available either as ASP (externally located software paid for on a rental basis) or on an Enterprise Basis billed as license fees and associated maintenance.

What is interesting about the different offerings is that their functionality appears to be converging: BIW’s application now includes flexible functionality to suit individual client business processes, and Business Collaborator is developing a more rigid “project extranet” product from its flexible tool kit.

Our survey indicates that BIW are the market leaders relative to project extranets; they have the largest number of users and their system is highly regarded.

Business Collaborator’s general collaboration system (which can be deployed as a project extranet, among other things) obtained the highest client score of all, and its adaptability gives the potential to take on BIW provided it can develop an equivalent sophisticated functionality.

Build Online’s ability to win major contracts with excellent clients, together with its track record of acquisitions, positions the business well, albeit that the client references were below par. The remaining organisations have all secured a good user base, although our conclusion is that the market cannot support this number of players. We expect to see at least one less participant every half year until the market settles on a remaining three.

See section 4 for more details relative to suppliers.

2/ Collaboration software and the construction industry

2.1/ Collaboration software - market scale.

Annual construction spend in the UK is £ 69 Billion, and over the next 5 to 7 years most of the processes associated with this activity will be carried out in a collaborative manner, founded upon the adoption of collaboration software.

The construction industry is, and will remain, highly fragmented. The industry's clients have varying approaches to managing projects, and projects vary from maintenance contracts to vast long term contracts undertaken by consortia. Projects comprise new build and refurbishment in commercial, government, industrial and domestic contexts.

Collaboration software market - UK	2003	2004	2005	2006	2007
Large projects:					
Average percentage cost	0.32%	0.22%	0.15%	0.10%	0.07%
Market (14% of construction GDP) : £B	£9.6	£9.6	£9.7	£9.7	£9.8
Market penetration	20%	38%	50%	74%	95%
Estimated size of (CS) Market : £M	£6.14	£8.03	£7.28	£7.18	£6.52
Served by:					
Specialist collaboration systems	99%	98%	98%	98%	98%
Generic collaboration systems	1%	2%	2%	2%	2%
Medium size projects:					
Average percentage cost	0.34%	0.28%	0.16%	0.11%	0.08%
Market (18% of construction GDP) : £B	£12.4	£12.7	£12.8	£13.2	£13.4
Market penetration	5%	13%	25%	40%	65%
Estimated size of (CS) Market : £M	£2.11	£4.52	£5.12	£5.81	£6.97
Served by:					
Specialist collaboration systems	95%	90%	85%	80%	80%
Generic collaboration systems	5%	10%	15%	20%	20%
Small projects:					
Average percentage cost	0.60%	0.45%	0.35%	0.25%	0.18%
Market (68% of construction GDP) : £B	£47	£48	£49	£52	£53
Market penetration	0.20%	1.20%	2.20%	4.20%	7.50%
Estimated size of (CS) Market : £M	£0.56	£2.59	£3.77	£5.46	£7.16
Served by:					
Specialist collaboration systems	50%	60%	65%	65%	70%
Generic collaboration systems	50%	40%	35%	35%	35%
Total estimated size of (CS) Market: £M	£8.82	£15.13	£16.17	£18.45	£20.64

Table 3 - Collaboration Software Market : UK

2.2/ The evolution of collaboration software.

In order to understand the use of emerging technologies, there is a need to understand the construction industry and in particular the intricate dynamics that shape the organisations that make up the industry.

The one thing that is indisputable is that we will need to maintain control over information, and to do that we need to impose order by applying procedures. This is why collaboration software is so important, not just to provide an infrastructure to support collaborative processes, but to maintain a disciplined approach to the management of information.

To put all this into perspective, the construction industry will soon have a level of transparency, synchronisation and automation that will completely alter business scale and operations, together with design and construction methodology.

Compagnia's conclusion is that the administrative burden and latency of information that plague the construction industry will be almost completely cut out of the equation, streamlining processes and enabling a more cerebral culture to develop. Construction has lacked research and development for some time, and is now close to having R&D resource as a part of every day business.

We must beware however that the pace of technological change can sometimes outstrip people's ability to adapt.

The future most certainly includes less non-productive time, and far more innovation.

Collaboration meets ERP.

A contractor's perspective of how software applications are deployed relative to the construction cycle (figure 6) shows that collaboration software reaches the parts other applications cannot

reach; Collaboration software is a project centric view that can be commenced at the design concept, and applied throughout the life of the building.

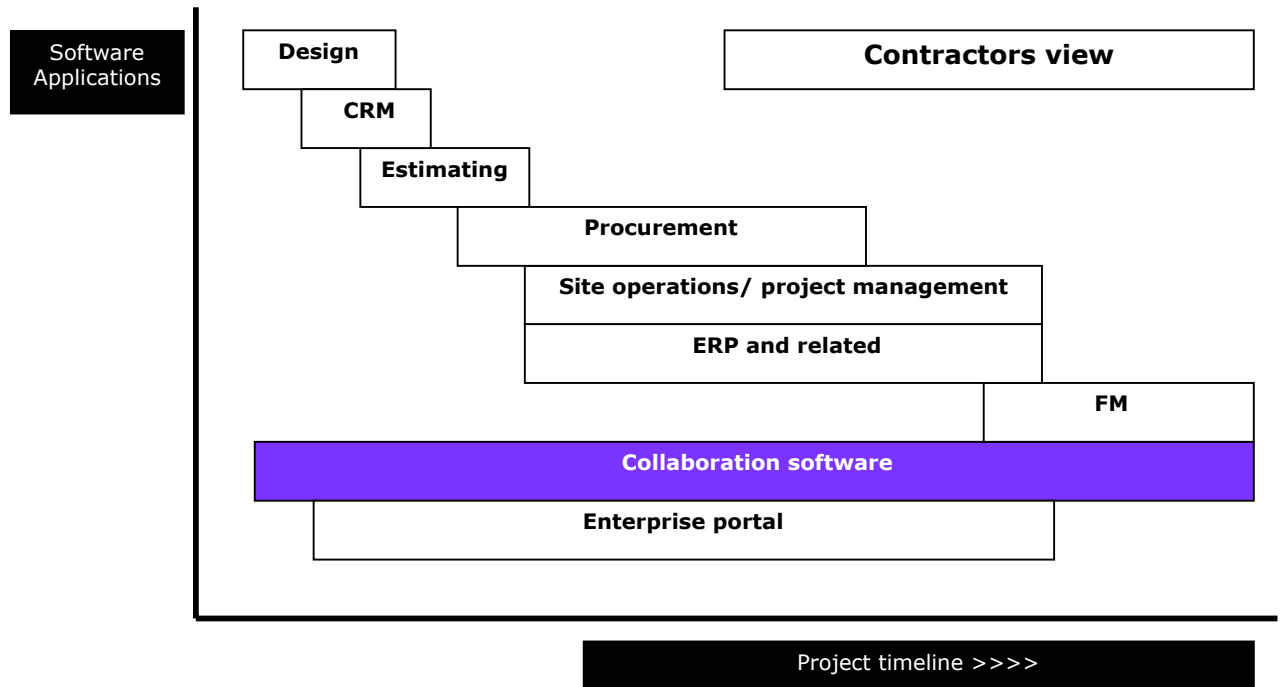


Figure 6 – applications relative to project timeline (contractors’ view)

Physicists talk about the “big crunch” (Figure 7) ,and there is every likelihood that construction IT will see its own version of the big crunch as IT suppliers that have focused on internet-based software coalesce, in varying ways, with traditional accounts and other principally off-line applications-based organisations seeking to broaden their offerings.

The indications from collaboration suppliers are that this is very much under way, but where will it lead?

We believe that ERP suppliers, the powerhouse of business IT, will ultimately absorb collaboration suppliers once suppliers have established sufficient market traction to achieve a sustainable viable operation.

En route to this event , which we estimate will take approximately 3 years to pan out, we also believe that collaboration suppliers will form relationships with design, project planning and estimating businesses (some already have) and that ultimately these relationships will form part of the “big crunch”.

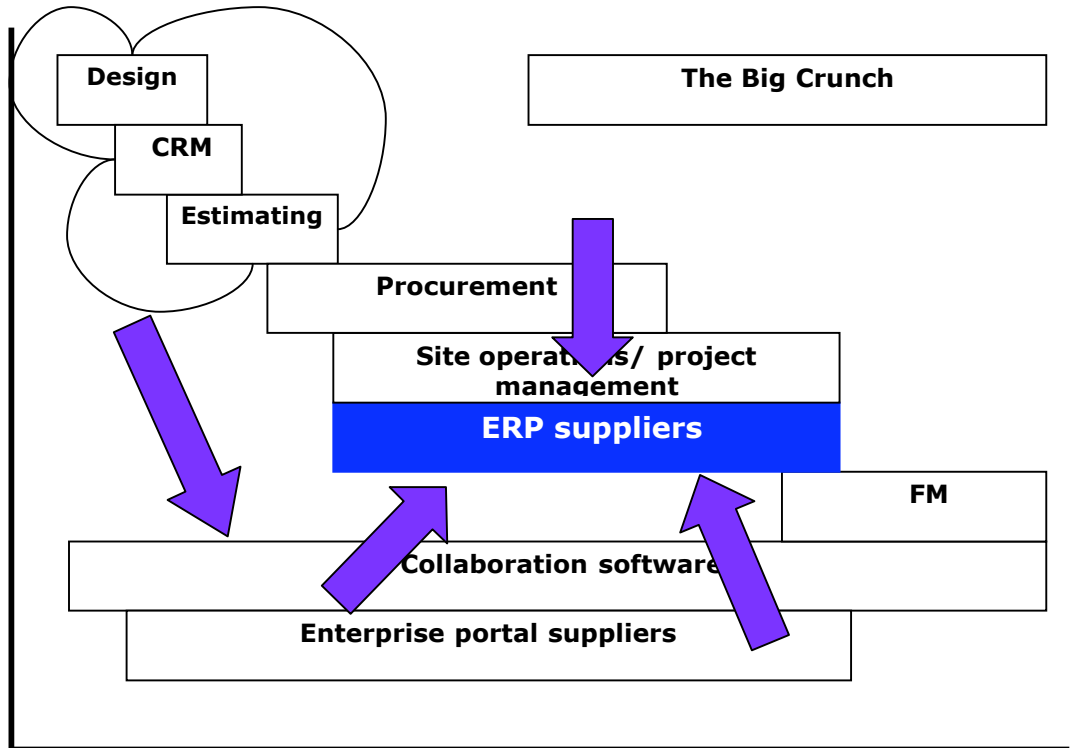


Figure 7- the big crunch

What we expect to see by about 2008 is the disappearance of pure-play industry-specific collaboration companies, as ERP vendors recognise the need to provide a more comprehensive offering.

Despite the looming “big crunch”, we see no justification for holding back collaboration software expenditure; the benefits far outweigh the cost.

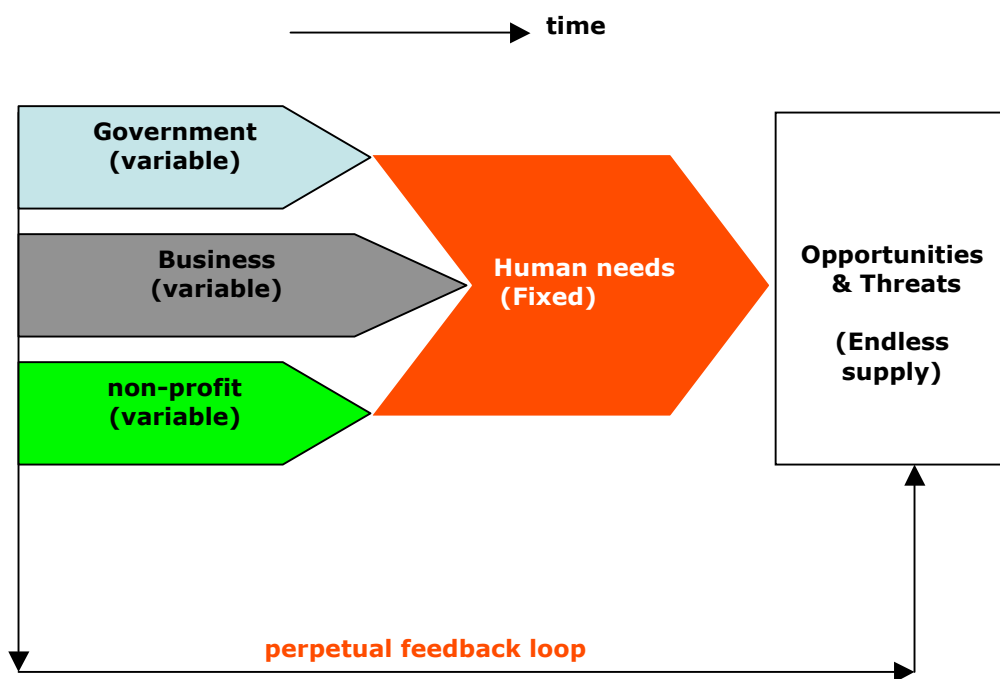
Table 4 sets out the likely effects on the basis of combining business axioms with the attributes that are provided by internet technology.

Topic	Immediacy	Connectivity	Community	Transparency
<u>Value Proposition</u>	Value props must take account of evolving technology, and the ways in which people respond.	Improved Connectivity, together with the resultant transparency and community will significantly alter the value proposition as organisations are able to draw on more resources and yet benefit from increased flexibility.		
<u>Business model</u>	New opportunities for business become available where there is a transforming technology that impacts upon the business model. Some business models (for example E-Bay, Amazon) only work with internet technology. The issue here is to search for differentiating opportunities that arise from the adoption of internet technology and then build these opportunities into the fabric of the business.			
<u>Strategy</u>	The increased speed of information generates new approaches to business.	Look for opportunities to link into clients' systems to forge closer working relationships.	Leveraged growth (the use of external assets) becomes possible due to the effect of more communal working.	Significant supply chain changes will occur over the next 5 to 10 years, creating innumerable opportunities.
<u>Organisation</u>	Immediacy is already having a huge impact on, for example, stock control which impacts significantly on profitability. Look for areas where immediacy can add value.	Respond to connectivity, it is already leading to an information explosion, which will (if not checked) reduce productivity.	Organisational structures will evolve rapidly as the time and cost of forming communities is eroded.	Transparency will affect the structure of the organisation by increasing awareness and breaking down traditional communication channels
<u>Mission</u>	The mission must adjust for the absorption of internet technology, do not treat it as an add on.			
<u>Numbers</u>	Information becomes readily available which impacts on performance. The reduced delays mean that decisions are made relative to recent events. Information moves forward in time!	Accountability for data increases, and is matched with more rigorous regs.	Enhanced visibility will compromise traditional processes.	
<u>Innovation</u>	Innovation will explode, and need to be managed as a process.			
<u>Focus</u>	Internet technology, and associated information explosion will challenge organisations to ensure their people remain focused. Businesses will fight even more for attention –hence the need for focus will increase.			
<u>People</u>	Immediacy will initially increase work-place stress, although as automation increases stress levels will dissipate.	We are all driven by the need to bond, learn, protect and acquire. Increased connectivity will lead us to make use of connectivity and community in ways that serve self-interest, which will lead to increased tension between employer and employee. Expect to see a more open approach to transferring knowledge across corporate boundaries.	Transparency increases the demand for information.	

Table 4 – Business fundamentals meet the Internet's attributes

Internet technology is a transforming technology that will cause people and organisations to adapt, resulting in a new set of market parameters. Whatever changes do take place however, human needs do not alter and represent a business axiom that many seem to forget when formulating business models!

In the wake of human needs (Figure 8) are the organisations that we formulate, these organisations and, in aggregate, markets, are continually re-shaped as our needs respond to new opportunities and threats.



Our need to communicate, our need for transparency to enable us to understand the (business) world and our need to be part of a community are among the drivers that compel us to embrace new technology and tackle change.

Figure 8 – Axiom: Human needs

The onward march of technological development will accelerate the evolution of the construction industry, and will impose change throughout business and elsewhere as social and corporate

structures struggle to evolve in order to seek competitive advantage through the use of new technologies and the organisational processes associated with them.

The construction industry's supply chain will evolve and we set out below the main areas and provide estimate of what the supply chain may look like in 2012 – see Figure 9.

The future of the construction industry's production supply chain – market segments

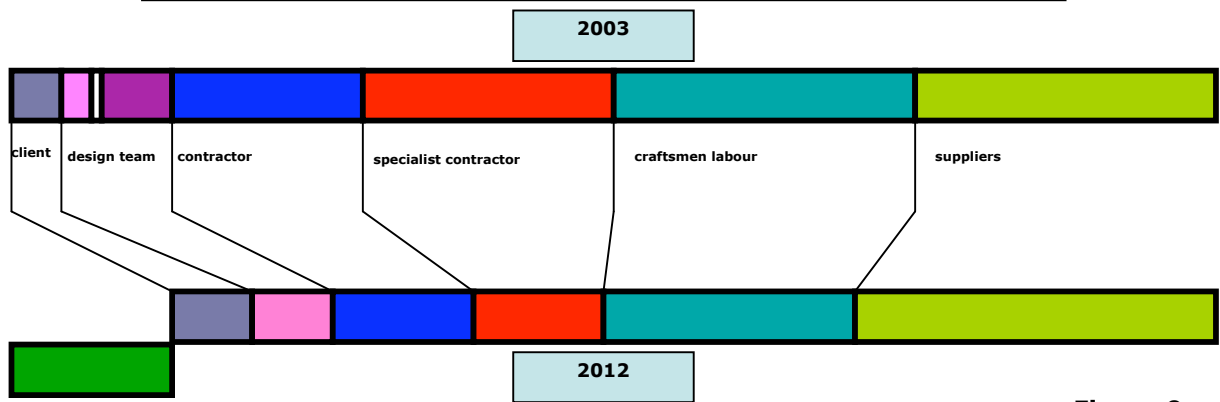


Figure 9

New huge army of independent specialist consultants

Client: outsourcing will increase client costs as outsourcing businesses pressure for more revenue potential within their offerings; as outsourcing businesses grow in scale, their power will enable them to have increased influence over client decision-making.

2003: 4% of project cost. 2012: 5% of project cost.

Design team: design teams will coalesce due to a number of factors, (1) availability of off-shore resource, (2) transforming technologies and (3) collaborative working will lead them to work together either within the same asset framework (i.e. a business) or in a more distributed fashion but under some kind of corporate or joint marketing umbrella.

2003: 2% project manager, 1% QS, 6% residual design team 2012: 7% total.

Contractor: there will be an increase in more innovative procurement regimes as project risk reduces with transparency. Contractors will remain the power base of the mid-supply chain as their financial and human resources exert a controlling influence "below" them.

2003: 15% 2012 cost: 14%.

Specialist contractors: specialists will be squeezed due to the effects of market transparency and improved communication. Transparency will reduce their value-add as their resources and skills become visible to contractors and clients. Market externalisation will increase the cross-border movement of specialists that will equalise costs throughout Europe.

2003: 19% 2012 cost: 10%

Suppliers: overall, there will be more pre-engineering due to a combination of inadequate skills and improved manufacturing (both in terms of manufacturing efficiency and for example in terms of materials technology). As with specialists, more open markets will increase access to better value that will challenge suppliers that have established markets in fixed geographic areas. The commercial strength of suppliers should not be underestimated though, and overall they will take a slightly increased market share.

2003: 27% 2012 cost: 31%

Craftsmen labour: despite the excitement of new technologies, craft skills will remain very much in demand although the market will "correct" increased costs.

2003: 25% 2012 cost: 23%

Independent consultants: there will be a considerable increase in the number of specialist knowledge workers that cluster around projects and businesses on a project basis. The specialists will vary considerably in age although they will all leverage technology to maximum effect.

2003: less than _ % 2012 cost: 12%

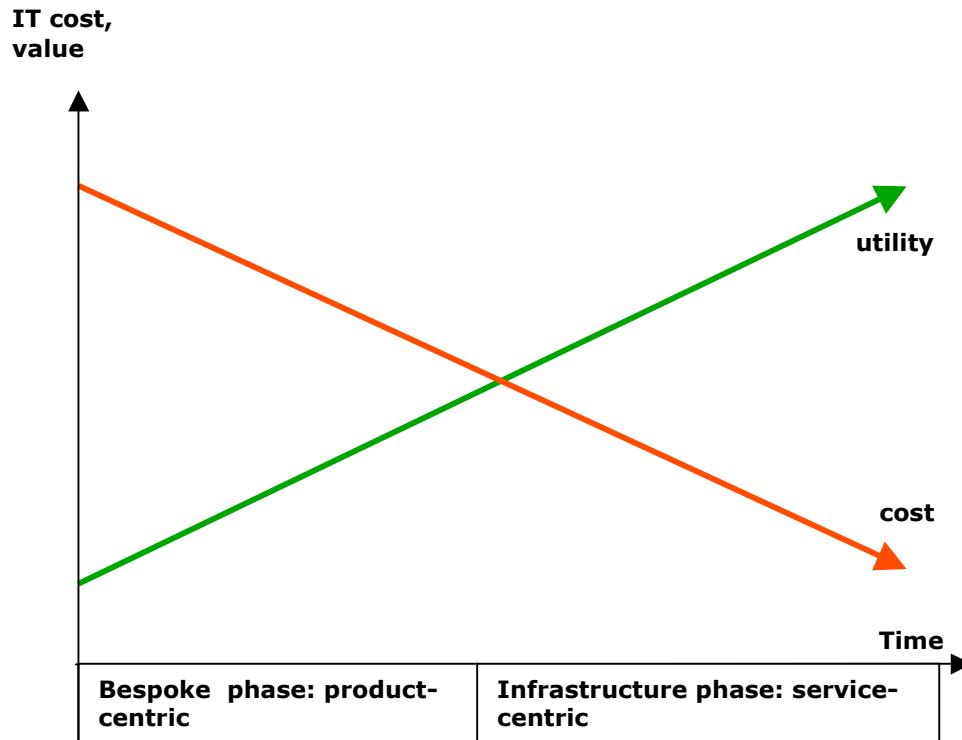
2.4/ Summary and conclusions

Collaboration systems will merge with ERP and other business systems to create a new business dynamic - Integrated Knowledge Infrastructure. The improved flow of knowledge from place to place will continue to improve personal and corporate intelligence.

Despite the benefits of collaboration software, ultimately it will be commoditised and open standards will prevent the emergence of a dominant player (see Figure 10). This process will take at least 5 to 7 years as the need for change management and support is a substantial ingredient.

In general, software will continue to reduce in price until, together with hardware, it becomes commoditised. This will result in a shift of service from being product-centric to being service-centric. In other words, IT will have become truly infrastructure upon which services are “delivered”.

Collaboration software will accelerate change in the construction industry, as clients demand more transparency.



Utility increases in inverse proportion to cost, which reduces until IT becomes infrastructure. Infrastructure provides foundation for series of next phase of transforming technologies.

Figure 10

3/ Management tools

3.1/ Introduction

Business and government have a tendency to forever add to administrative burden by adding cumbersome processes, thus shifting focus away from production towards the generation of endless “paperwork” concerning which information has to be gathered, reviewed and actions taken.

Our conclusion is that organisations need to formulate an operational architecture that: makes communication transparent; builds innovation into everyday processes; and continuously reduces administrative burden.

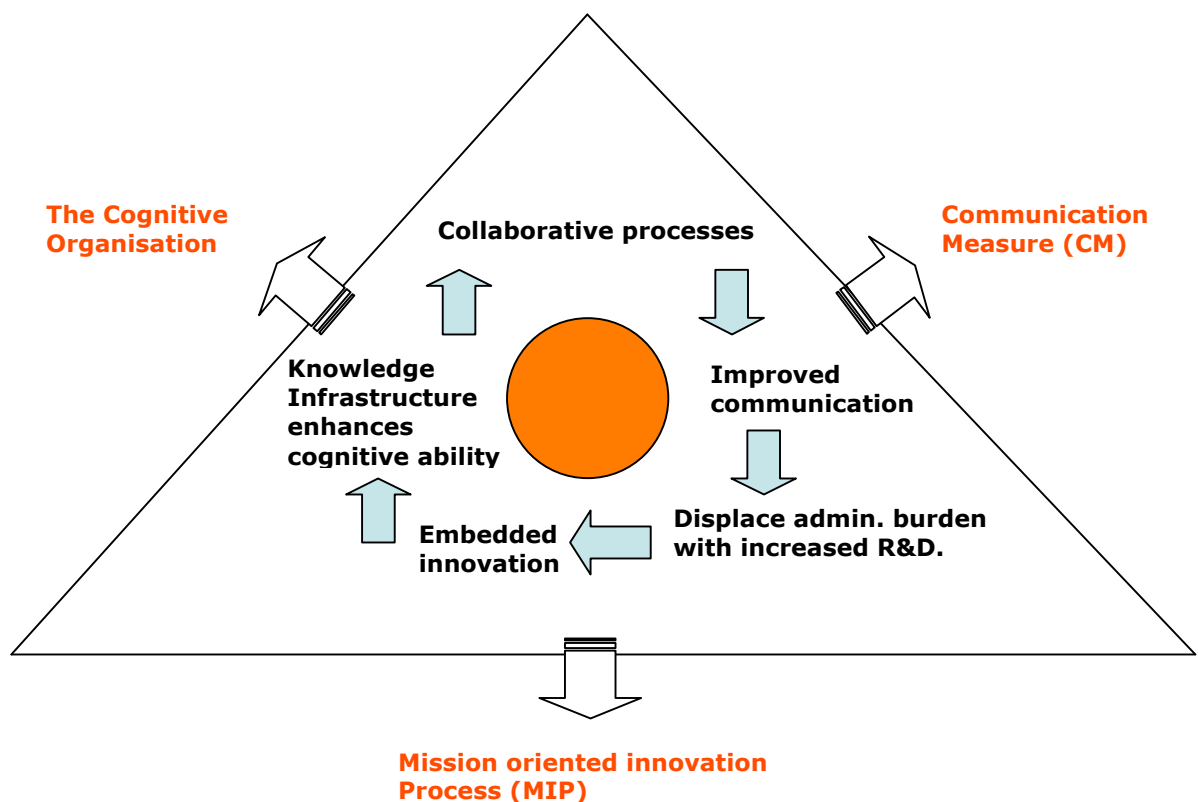


Figure 11

Collaboration software introduces new possibilities, which can be leveraged to provide a measure of communication within a system of people and to integrate innovation into everyday business operations.

3.2/ Communication Measure (CM)

If all the knowledge within a client and its supply chain (the tacit knowledge that resides within the people involved) is utilised on a project then the project will meet cost, quality, time and safety objectives subject to the needs of participants (deemed to be competent) being satisfied within the contractual framework established – provided the framework is established and maintained on the basis of trust and equitable risk.

Many business problems are due to a lack of knowledge, caused either by poor communication or because people withhold knowledge - due to a conflict of needs.

The CM is a new process that sets out to measure communication between project team members and is about cutting to the heart of the issue by questioning the value each project team member puts on the value of communication from other project team members.

The Knowledge Infrastructure provided by collaboration software makes it easy to undertake the CM process, enabling management to take corrective action to ensure that communication value is maximised throughout the project process.

There are well-established parameters that outline the way in which we communicate with each other.

a/ Communication in = communication out, less equivocation

b/ Information is conveyed subject to the constraints of business, which are founded upon the desire to protect needs.

c/ Information can be hampered by: the cost and energy required sending it, the timing of what is being sent, working hours, and personal relationships.

d/ Information is usually constructed on a “this is what I need to know” basis rather than “this is what the team needs to know, how I can address that?” basis.

e/ Information in meetings is conveyed subject to the prevalent social dynamics that apply, so for example where there is a chairman who talks continuously, information flow is reduced far below the potential.

f/ There is a balance between listening and talking, and only a few people seem to have the gift!

g/ Peer pressure has a significant affect on communication, as people tend towards keeping within the crowd.

h/ Scientists refer to affects known as “distance decay” and “least effort” relative to communication across distances.

i/ There are “patterns” to meetings that facilitate better or worse communication. For example, a meeting consisting of more than 8 people will lead to a reduction in the flow of information whereas a one to one meeting between to people who have equivalent knowledge is usually where maximum information exchange takes place.

j/ Communication improves when people have less administrative burden.

k/ The chain of communication (throughout an organisation and its supply chain) is like a series of distorted lenses, as each participant makes sense of the information received and then adjusts to suit their needs.

l/ Some senior managers attract deferential subordinates thus reducing the value of communication and often filtering out information from elsewhere in the business.

m/ communication is conveying information to negotiate a need, and is built on a biological architecture that evolved over millions of years.

The quality of information flow increases when these parameters operate in accordance with: unilateral satisfaction of business needs, and where people provide objective and unencumbered input that is communicated at a level that can be understood. We cannot hope to realise perfect communication, but the closer we can get to it, the better we will be at providing a service to our clients.

The communication efficiency index (CM) relies on three main inputs:

1/ Measured communication between project team members.

Communication is measured by individuals relative to the extent to which team members depend on each other for information. The feedback is unilateral and does not take hierarchy into account.

2/ The transparency of the project team network.

Supply chains include hidden information because people communicate via intermediaries. The objective is to map out the supply chain to ensure that useful information is available when and where it is needed.

3/ The aggregate perceived need for additional input, i.e. information that is not currently available within the project team or the visible supply chain.

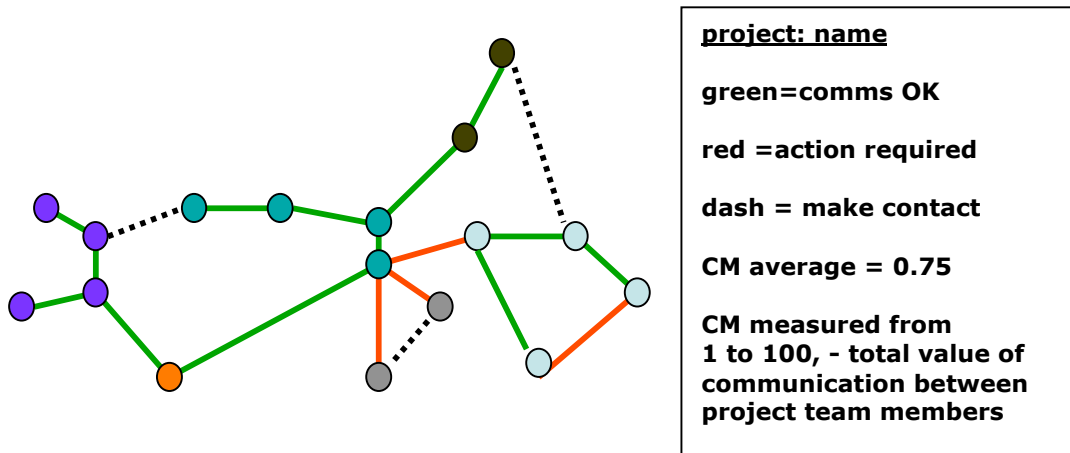


Figure 12 – graphical representation of CM – design team

The CM network diagram (Figure 12) provides a graphical representation of the information dependencies together with a measure of the communication values between project team members. We estimate that this process would take a day to set up, and about _ hour per project team member per month to update.

Clearly, there must be adequate motivation for participants, not only in terms of corporate interest, but also in terms of personal interest.

Corporate interest comes from the need to obtain competitive advantage through, amongst other things, service differentiation. Clients are motivated to participate because if their supply chain is communicating well, this will crystallise in the form of increased value through increased productivity.

Personal interest applies also, to the extent that people who have a common objective and share interests are naturally predisposed to share information to enable them to bond with their peers, and to increase their knowledge by learning at the work face – the most effective environment for learning. People also prefer to know what their peers think about them, they welcome feedback.

CM sets a standard so that project teams are compelled to continuously improve cost and quality. As an industry standard, CM will therefore provide participants with a measure for their past performance; CM also enables project teams to focus on improving communication and therefore to leverage technology and new processes to maximum affect.

At a personal level, CM encourages people to think more in terms of “group” than “self” and thus reawakens our awareness of community, sometimes lost when we are located disparately.

3.3/ Mission oriented innovation process (MIP)

Creativity is producing original and useful ideas; innovation is the use of new ideas to solve problems. The problems that business solve always relate in some way to satisfying a need.

Innovation can be built into a business, just like any other function. In other words, it should become ordinary and a part of everyday work.

“Mission oriented” refers to the fact that there is a clear definable purpose in mind, such as constructing a new building. Missions could also relate to an objective to reduce procurement process cost within 12 months; what is vital is that the mission is properly defined, along with a number of key performance indicators, to ensure that resources are focussed on the objective (mission).

The internet has added new capability to business, namely immediacy, community, transparency and connectivity. We are therefore better poised to integrate innovation in everything that we do; the challenge is how to do it without disproportionately disrupting everyday duties.

The respondents to our survey indicated that, on average, innovation increases as a result of collaboration software because they now have better communication systems which improve communication between people both within and external to their organisations. The improvements in innovation did depend on there being processes in place that captured the innovation.

The way in which we structure organisations today tends to have an adverse impact on innovation for the following reasons:

1/ we tend to separate innovation from the “work-face”

2/ prevalent business culture does not accept failure which is a necessary part of innovation - failure doesn't mean jeopardising the project, it is in the context of trying out a new system within the boundary of established priorities

3/ there is little scope for the consilience – the unification of knowledge across different disciplines

4/ innovation is usually treated as a woolly area and (as applies to construction) fails to get its fair share of spend

5/ too much, or even too little stress can prevent people from having the necessary state of mind to be creative; too much stress and people suffer from conditions such as post-pressure cognitive paralysis, too little and they can lack motivation

6/ innovation involves a high degree of decision making, much of which is challenging because of the nature of the decisions, sometime into unknown or at least unfamiliar territory – with management teams averagely over-burdened, adding further processes (even when they are demonstrably beneficial) can cause resistance

7/ organisations tend to look for quick fix all-in-one solutions, innovation is incremental and should be seen more as a long term sustainable goal that builds innovation into the business, rather than a panic response to a series of immediate problems

8/ making time to think – in effect buying quality thinking time – is a great challenge for all organisations and yet it is the most important thing to do

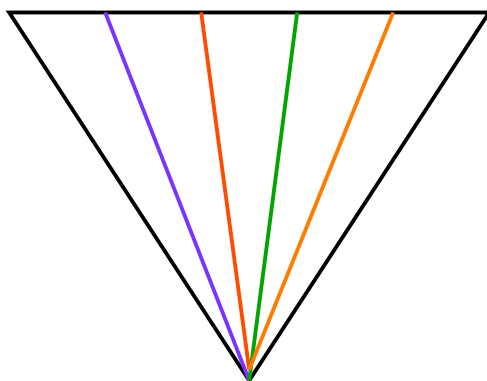
Integrating innovation into an organisation requires that we address three issues: people, process and technology.

3.3.1/ People and innovation.

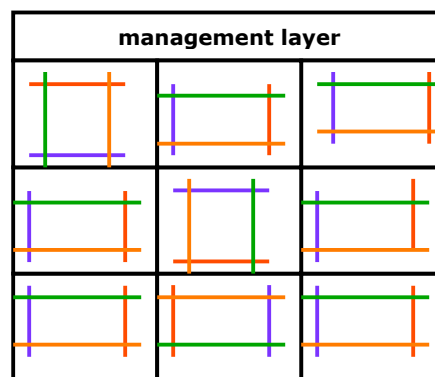
Innovation can be managed, people can be taught how to be innovative when working and the social networks that form companies can be configured in ways that make innovation sustainable. Employing people with diverse skills and talents helps us challenge the status quo when developing new strategies, products or services. In construction, we need to ensure that we are making the best use of these diverse skills.

If we draw an organisation on the basis of power distribution, we get an inverted pyramid. Within the pyramid, there are vertical lines that point toward the inverted apex. These vertical lines indicate departments – sales and marketing, finance etc. There is little scope for the cross fertilisation of new ideas, and often problems within one part of the business are not communicated elsewhere. The working face has virtually no power as it is distributed somewhat disproportionately to management.

Companies that have managed to make innovation an everyday part of their business have structures that look quite different, as they comprise a matrix structure with a reduced managerial layer. The matrix still has the necessary inclusion of a hierarchy, but it improves communication within the organisation by reducing barriers and generating an environment conducive to thinking and innovating.



**Traditional:
Skill silos and uneven
distribution of power**



**Collaborative:
Cross functional teams and
distributed power**

Figure 13 – distribution of power

We are all potentially innovative. There is a need to learn how to be innovative within the context of the objective of making innovation pervade what we do every day, and thus begin a continuous sustainable cycle of innovation that improves the organisation.

The keys to us being innovative are: learning, insight, realisation, and awareness leading to questioning, clarification & feedback, recall, and focused concentration. This means that we need

to somehow create time, which is where the benefit that IT brings us – significantly reducing administrative burden – comes into play.

People who are successful at innovation have energy and enthusiasm, daring and endurance – getting people to accept that the way they work is not the best way is a huge challenge!

Scientists say that people who allocate more time to exploratory behaviour while doing a task produce more creativity which, through their understanding of the subject, leads to innovation. This endorses the need to make innovation a part of every day work.

3.3.2/ Process and innovation

Process begins with specifying the areas for improvement, and setting clear and measurable objectives in the form of key performance indicators.

Innovation can be applied to products, services, business processes, business relationships and indeed to every aspect of an organisation. In order to ensure it remains a part of everyday work we must set out processes and assign them to the right people.

Innovation breaks down into the following categories: unexpected occurrences (e.g. an invention that was intended for a use, but could be applied elsewhere), incongruities (the development of a new way of doing something because of a change in market conditions for example), process needs, industry and market needs (structural change to an industry always creates huge business potential), demographic changes, changes in perception, and new knowledge (we all saw the response of the market to internet technology).

Collaboration software enables an organisation to more easily build teams that span the entire supply chain, further increasing the scope for making use of knowledge. It is now also more practicable to include academia in the collaborative processes and companies should seek

opportunities to do this regularly. Where outsourcing is applied, companies should ensure that they do not lose the access to knowledge that vests with the outsourcing business.

Establishing the right environment for innovation is vital, organisations need to: value performance, carefully structure the organisation so that it makes room for innovation, apply strategic focus to channel innovation, set out the areas where innovation will be applied and ensure that over time all aspects are covered, filter good ideas and pursue them with adequate resources. Innovation cannot be forced, but it can be encouraged.

Innovation is an incremental process and is dependent upon a balance between time pressure and the extent to which a team is creative. A high level of time pressure and creativity usually leads to focus, energy and a more collaborative approach to working as people recognise the need to work as a team. Low levels of time pressure and poor creativity lead to a large number of ineffective meetings, reduced collaboration and little encouragement.

A systematic approach to innovation can work, provided the systems in place align with the business structure. Russian engineer Genrich Altshuller devised a method of applying 5 processes to product innovation, these are: subtraction (removing features so that the product satisfies a different need), multiplication (adding new functionality by making a minor modification to an existing element), division (by dividing the product into parts, there is a new perspective which can lead to a new product comprised of the existing parts recombined in some new way), task unification (using a product to satisfy a quite different need than the one it was originally developed for) and attribute dependency change (the dependent relationships that exist between the attributes of a product and the attributes of an environment can be altered to create new, or even more limited, dependencies that give rise to new products).

3.3.3/ Information Technology and Innovation

Innovation increases proportionately with increased communication, and communication is better when barriers are removed yet controls and hierarchy remain. Internet technology is

incrementally improving communication and innovation as we continuously learn how to better harness our new resource.

Clearly, internet technology is a transforming technology because it reduces the cost of communication, and it reduces the cost of innovation.

3.3.4/ Mission based innovation process (MIP)

We recognise that innovation occurs throughout projects, our concern is that it is sporadic and generally in stimulus response. For example, a client will be made aware that cost is over budget, resulting in a cost purge.

MIP is a process, founded upon collaboration software, which establishes mission-based innovation throughout all stages of the project and beyond.

The client must drive participation in collaborative innovation, and there must be provision for intellectual property to be assigned an owner.

We believe that to ensure innovation becomes a part of the process, the mission oriented innovation process should be built into collaborative systems (and therefore collaborative processes) so that project teams are compelled to innovate on all fronts, continuously.

A purposeful approach to developing “corporate intelligence” will provide businesses with competitive advantage over those organisations that struggle to apply these processes.

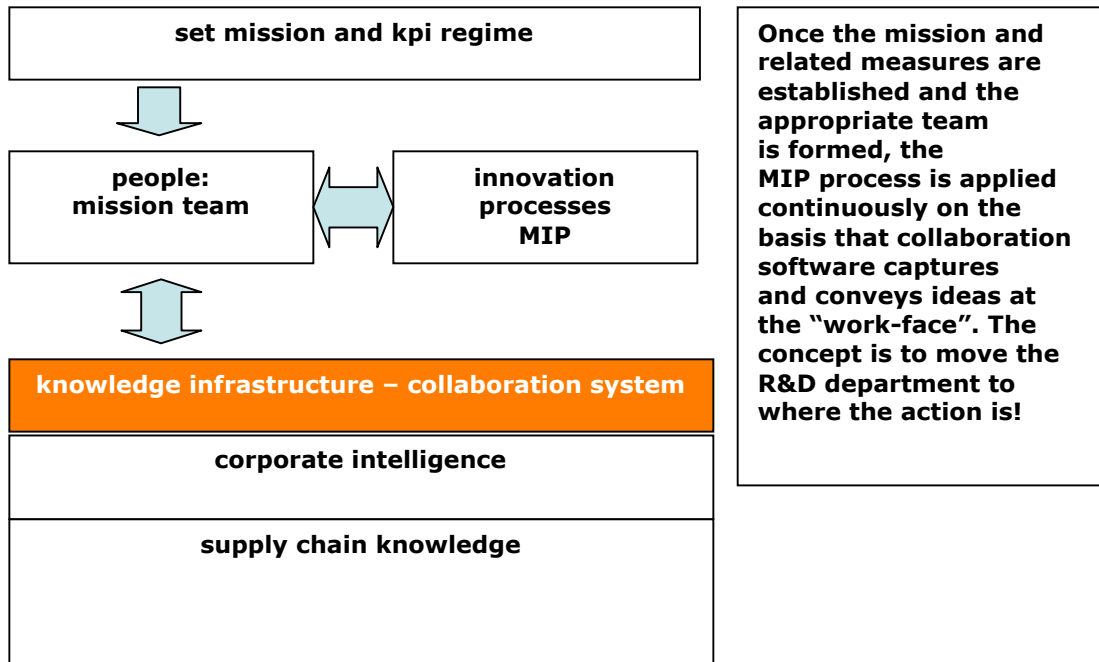


Figure 14 – Mission oriented innovation

4/ Supplier review

The following are outline reviews of suppliers, for a more detailed analysis contact Compagnia at www.compagnia.biz

- 4.1/ Aconex
- 4.2/ Bidcom
- 4.3/ BIW Technologies
- 4.4/ Build Online
- 4.5/ Business Collaborator
- 4.6/ Cadweb
- 4.7/ Causeway (Livelink)
- 4.8/ Sarcophagus
- 4.9/ 4 Projects

4.1/

Australian Construction Exchange Pty Ltd (Registration no: 49 091 376 091) Aconex	
Client score: 7.6	Number of users: approx 5000 (Australasia only)
Compagnia review: Aconex has recently entered the UK market, following a successful launch in its home market - Australasia. The company has recently won its first UK contract serving a "top 20 UK contractor". The product is a process-based collaboration solution that supports project management and procurement functionality. The company claims that it can support users anywhere in the world and has sales representation in Australia (primary), Singapore and EU and has trial projects in Chile and Venezuela.	
Main clients: McDonalds Becton Probuild CPG KSIG Smorgon ARC	
Customer (user) feedback: Users were positive about the system, and the level of support provided by Aconex. The data related only to operations in Australia.	
The benefits of using Aconex, supplier perspective and Compagnia review: (1) Aconex integrates document and correspondence control functionality together with procurement applications. This allows companies to save money and increase control across the design/procure/build/manage cycle Compagnia: this is a generic function of collaboration systems. (2) Aconex is easily deployed as a stand-alone system, supporting 1-100 000 users. This allows companies to choose the most cost-effective option, and, if they wish, to use Aconex as an extranet/intranet solution Compagnia: deployment options are a benefit, although many of the suppliers we have spoken to are prepared to offer similar options. (3) Aconex developed all the key technology itself, in-house. And the technology is based on open source languages. All development know-how is in-house. This means we can flexibly and rapidly develop as market needs and technical limitations evolve; we can re-sell the entire system without paying additional license costs. Compagnia: maintaining total control of IP is benefit, although it carries increased product development risk. The Aconex system has established sufficient track record in Australasia to offset concerns about system credibility. (4) Aconex has several hooks to help collaboration users transact and communicate with external users, including: <ul style="list-style-type: none">• automated email import and linking facility• fax import• Direct save from Microsoft Office	

- **Public tender pages**

Compagnia: although not unique to Aconex, this functionality streamlines the system use.

(5) Aconex has an extremely intuitive and easy to use interface and claims to have significant levels of positive feedback regarding Aconex's GUI compared to its competitors.

Compagnia: the system does work well, although this is not considered create a competitive advantage.

Technology:

Aconex is a 100% Java application running on a choice of operating systems and databases and currently has installations running on the following OS/ DB configurations: Linux / PostGRES, Windows / Microsoft SQLserver, Windows/ MySQL

Users can save documents directly from MS Office applications into Aconex

Web services:

Aconex is aware of the need to approach web services and indicated with the response "every data stream in the system can be persisted as XML flows. This, together with the open architecture and unrestricted control of all components of our system, means we will be well-placed to respond to developments in our clients' needs. At present, construction companies are having enough trouble powering uptake of the basic collaboration module throughout their supply chains. Future advances in technology must occur without adding additional user complexity".

Interoperability with other collaboration systems:

Aconex already has several hooks from other systems, including:

- **automated email import and linking facility**
- **fax import**
- **XML & CSV exports**
- **Direct save from Microsoft Office**

Number of staff:

Technical 10, Sales 4, Management and Admin 4.

4.2/

Bidcom Ltd (Company number 4020777)	
Client score: 7.0	Number of users: 6000 (UK)
<p>Compagnia review:</p> <p>Bidcom Ltd is a wholly owned subsidiary of US company Citadon Inc, which has established considerable market traction in the US where it has over 30,000 users.</p> <p>Bidcom’s collaboration product, ProjectNet, is used worldwide. Citadon Inc, operate within the America’s and Far East. Bidcom Ltd operates within Europe, Middle East and Africa. The company has secured excellent clients throughout the world.</p> <p>ProjectNet’s client scoring was a disappointment, and indicates that there is a need to balance functionality with use-ability.</p> <p>ProjectNet is a process collaboration system, and it incorporates procurement and project management functionality.</p>	
<p>Main (UK) clients:</p> <p>GMPTE , Metrolink, IKEA, Transport for London, Wilson Bowden, EC Harris, Wates, Carillion, Exxon Mobil.</p>	
<p>Customer (user) feedback:</p> <p>Users mentioned that the system has excellent functionality, but that this did not quite provide the level of benefits that had been anticipated.</p>	
<p>The benefits of using Bidcom’s product – ProjectNet - supplier perspective and Compagnia review:</p> <p>(1) Available in 7 languages (English (UK, US), French, German, Spanish, Simplified Chinese, Japanese) – therefore effective worldwide deployment. Compagnia: The extended reach, supported by the parent company in the US, will enable Bidcom to benefit from increased customer input, a critical element in developing collaboration systems.</p> <p>(2) Simple Microsoft Outlook UI enabling less training requirements. Compagnia: User interface is important to ensure fast adoption, although users of other systems were generally quite satisfied with the other user interfaces.</p> <p>(3) Multiple file upload and auto packaging of computer aided design drawings. Compagnia: this functionality (particularly multiple file upload) is now considered essential.</p> <p>(4) Integrated Reprographics printing capabilities allowing easier bulk printing and distribution. Compagnia: this is a realistic introduction, and although it is a great addition to the service provided, it is not unique.</p> <p>(5) Forms status, storage and access reporting allowing quick effective project reporting. Results exported to screen or spreadsheet. Compagnia: excellent functionality as this enables the collaborative processes to extend further than procurement and project management.</p>	

Technology:

ProjectNet is based on a 3-tier architecture and was designed for the Internet. It incorporates technology from Sun, Oracle and BEA. Integration of ProjectNet with external third party applications is achieved by utilising the XML-SOAP standards based Application Programming Interfaces (APIs) of ProjectNet, which have been published by Citadon.

The ProjectNet Platform Integration API provides external enterprise client applications a gateway to access ProjectNet application functionality. Client applications exchange data with ProjectNet through the platform integration layer using HTTP/XML (SOAP) technology. The ProjectNet Web Services API is a request (/response) based API. Client applications send requests to the ProjectNet platform integration layer via one API, "ProcessCitadonRequest". From this gateway API, client applications have access to the various application specific services such as Uploading Documents, Creating RFI etc

Other collaboration systems can use the Published APIs to interact with ProjectNet. ProjectNet has been integrated with Windows Explorer for Document Management activities and ProjectNet Calendar and Task Management Module has been integrated with Microsoft Outlook.

Number of staff:

Technical 4 , Sales 3 , Management and Admin 3. (UK only)

4.3/

BIW Technologies Ltd (company number 3011107)	
Client score: 8.5	Number of users: 23,000
Compagnia review: <p>Founded in 1999, BIW is staffed by a range of construction and IT professionals. The board includes Sir Michael Latham, whose construction industry report made a significant contribution at a time when the industry needed to raise its game.</p> <p>BIW's management team has the benefit of extensive software sales in the construction industry, and the company's approach to sales and marketing has enabled it to develop a powerful client portfolio.</p> <p>BIW coverage is in UK & Ireland and the Middle East and has industry partners across Europe (Gleeds, ISG, Kajima, Mace etc).</p> <p>BIW also produce a Plan Weaver – a highly sophisticated design process optimisation product that has significant potential and compliments the collaboration system. Plan Weaver could become a world class product once it has established sufficient market traction.</p> <p>BIW is a process collaboration system, and although the main focus is project management functionality, the system includes new functionality to enable clients' to apply their own processes which could, once further developed, enable procurement functionality to be added.</p>	
Main clients: BT, Sainsbury's, United Utilities, Kajima, Bovis Lendlease, Skanska.	
Customer (user) feedback: Users were satisfied with the product and the service levels.	
The benefits of using BIW, supplier perspective and Compagnia review: <p>(1) The whole strategy of BIW's product strategy is based upon application and service quality. All aspects of the application, its delivery, security, SLA's etc are designed to ensure the highest levels of quality and therefore operational effectiveness for users. Compagnia: BIW have established good client relationships and a large number of users – to date, the largest number in the UK.</p> <p>(2) BIW Information Channel is focused on helping to implement collaborative processes (across external processes) that surround the development, creation and operation and maintenance of an asset. The asset is the core, projects belong to assets and processes span both e.g. health & safety.. Although the application supports the management of documents and their individual lifecycle, documents are subsets of processes. Compagnia: BIW have a strong understanding of construction, and this reflects in their approach.</p> <p>(3) Design and development of its own viewers allows BIW to embed specific functionality within the detailed structure and auditability of the application. For example, the integration of real-time collaboration / white boarding / conferencing is being designed within the application rather than interfacing to</p>	

third party applications.

Compagnia: We do not see a great advantage to this, other than that BIW maintain the IP.

(4) A collaborative process management toolset has been designed to allow clients to develop their own processes. This toolset is not a workflow toolset and is designed specifically to support the effective creation of flexible networks rather than rigid production lines.

Compagnia: Clients clearly need to have flexibility to suit their own processes, but also need to align business processes to suit the supply chain.

(5) The intellectual influence of the application by some of the leading AEC practitioners and their continued investment in BIW's applications mean the true depth of the functionality is powerful.

Compagnia: BIW's offering will benefit from the knowledge that their clients will migrate to the system (through user groups and general feedback).

Technology:

BIW Information Channel collaboration software is a second-generation ASP product. It was designed from first principles to be deployed over the web and is not a migrated client-server architecture.

The software is developed using Microsoft development tools and data is managed in SQL Server, a relational database management system.

BIW has chosen to adopt Web services as future technical infrastructure and have selected Microsoft's .NET as the technical platform. All developments and enhancements are now undertaken with this technical strategy and compliance in mind.

**BIW's system integrates with:
Ramesys Xchange portal
Bovis Hummingbird DMS
SER drawing management system**

Number of staff:

Technical 24, Sales 4, Management and Admin 8.

4.4/

BuildOnline (UK) Limited (Registration number 3863610)	
Client Score: 7.1	Number of users: Approx 10000
Compagnia review: Build Online's success has much to do with its ability to acquire organisations as it does with a reliable technology.	
Main clients: Balfour Beatty , Kier Build, Bilfinger Berger, Stragbag, OFB, Transco, Thames Water, Metronet, Ballast, Mowlem, Carillion, National Grid, Highways Agency	
Customer (user) feedback: Below what was expected, but expect this to improve as the company refines its product to suit clients' needs.	
The benefits of using Build Online, supplier perspective and Compagnia review: (1) Integrated Online Tendering Compagnia: a benefit because the more processes that are integrated the greater the benefit. Collaboration applies as much to procurement as it does to project management. (2) Integrated Workflow Management Compagnia: Workflow can be a benefit as it provides business process automation and streamlining conveyed via intuitive graphical representation. Always a danger though is to migrate too much work to a virtual environment thus creating a new barriers. Workflow can become very difficult when it encompasses processes from a number of organisations. (3) X-Ref functionality Compagnia: Not unique to Build Online, but an excellent feature. (4) Document Mark-ups saved as information in the database rather than as separate versions of the document. Compagnia: we do consider this a major benefit over the alternative. (5) Integrated viewer that handles over 300 different file types Compagnia: this is not unique to Build Online	
Technology: BuildOnline uses three-tier systems architecture, separating web servers, application servers and database servers. Each tier in the architecture is separated by firewalls for protection, and a further two firewalls face the public Internet. The entire system is load balanced to enhance performance, and each server has enough RAM, CPU and disk storage to meet the company's volume projections over the next 18 months. BuildOnline uses "best of breed" technologies in its systems architecture,	

which includes: Server Technology Based on J2EE technologies (Sun Microsystems) running on UNIX platform, using Oracle 9i relational database.

Build Online has had XML interfaces built into the product for the past 2 years and currently provide an offline archive of all documents, meta-data, document history and user history available in an XML format so it can be incorporated into other product sets.

BuildOnline's approach to interoperability with other systems is to provide a standard set of Application Program Interfaces (APIs) that provide a controlled, secure yet open method of working with our products. BuildOnline is also an active member of the BE group which comprises of UK based collaboration providers who are working together to agree standards for inter-product collaboration.

**The Projects Online system provides standard integration with:
Microsoft Office - Outlook/Exchange**

Standard APIs are also available to allow integration between Build Online's system and other business critical applications.

Number of staff:

Technical 25, Sales 7, Management and Admin 5.

4.5/

Business Collaborator – CodaSciSys plc	
Client Score: 8.7	Number of users: 15,000
Compagnia review: Group BC was recently acquired by CodaSciSys plc and therefore has the largest backer of all the collaboration suppliers in the UK. Group BC's product has grown without funding from external investors, and is being used by a selection of clients for a range of (collaborative) purposes. The company's people represent probably the most cerebral group in the market, and this is reflected in the technology that has been designed to provide a flexible system that is more adaptive than the process versions offered by competitors. Business Collaborator can be deployed to deliver a number of collaboration systems, including project management, procurement and knowledge management including enterprise portals.	
Main clients: Costain, Balfour Beatty, Royal Bank of Scotland, and Chelsfield (White City project), WS Atkins, Nationwide Building Society.	
Customer (user) feedback: Group BC's product – Business Collaborator – scored the highest client satisfaction with users pleased that the system offers flexibility.	
The benefits of using Business Collaborator, supplier perspective and Compagnia review: (1) XML architecture provides: a) Customisable interfaces – Look and feel, Ease of use etc. b) Device independence: Accessibility from other devices (e.g. PDAs, WAP phones etc.) c) An API to the XML objects Compagnia: we applaud the development of a truly open architecture. (2) A built in Relational Database toolkit – Provides: a) The ability for any user (irrespective of programming knowledge) to create a web based RDB applications without having to purchase and distribute additional Database packages. This has been used extensively to create applications such as: Contact databases, Drawing Registers, RFI and RFQ apps, Feedback and snagging apps, CV repositories, timesheet applications. Compagnia: this is at the heart of the collaboration system, the ability to centralise and align business processes. (3) Enterprise portal (Third part application integration) – BC can connect to any application that is run on an ODBC compliant databases. This includes applications that utilise SQL Server and Oracle amongst others. BC's built in Wizards allow web forms and web reports to be created from data contained within third party databases. The tool allows authorised users to read and write into back end applications from a single web portal. Applications currently in use include, Nationwide Building Society's Programme Management application, which is based on SQL server and manages the maintenance programme of NBS branches. Costain's myPage application that	

allows all Costain staff to update their CVs on line and others to search for employees with relevant skills. The application links in with their HR application PWA and Active directory.

Compagnia: aside from flexibility, this is BC's other main advantage over its competitors.

(4) Drag and Drop and Save from Windows:

- a) **Drag and drop** – This allows users to upload hierarchies of data with a single drag and drop action from their file system. The folders of files are initially compressed on the user's computer, the entire contents are then sent to BC in compressed form, on arrival the contents are uncompressed, the hierarchy recreated on the server and the contents uploaded to the appropriate folders on the server.
- b) **Save from Windows:** Once against this feature is designed to provide maximum ease of use to the end user. The feature allows users to Edit documents (any document not just Microsoft Offices ones) and to Save these directly to the collaboration server from within the application. The feature also provides a monitor tool which checks with the server to ensure that the document is not being edited elsewhere. A user can open, edit and save documents on the collaboration service without opening a web browser. This allows users to work in a natural way. E.g User opens Word, selects a document from their Recent Documents lists, Edits the documents, hits the save icon in Word and voila! Compare this with having to i) open up the web browser, ii) type in the URL of the server, iii) Navigate to the folder where the document is contained (or use search on Meta Data), iv) Save the document locally, v) Edit the document, vi) Save the document locally, vii) open the browser when editing complete, viii) navigate to the correct folder and finally ix) upload.

Compagnia: BC focus efforts on streamlining processes, thus avoiding new hurdles often encountered with IT systems and their built-in processes.

(5) Design Management – BC has been working fearlessly to provide a Design Management (Process Management) component within its product. The developments have been carried out with input for a BC focus group that involved BC clients that covered the entire life cycle of a construction project (i.e. from feasibility to FM). The work has resulted in what we believe is state of the art Design Management. The developments extend BC's built in document Management system by incorporating configurable meta-data, issue (submittal) tracking, intelligent searching, further email integration and a lot more. BC are currently scathing the service as far as the exploitation of the recent developments are concerned.

Compagnia: we were unable to assess the impact of this on users, but did review the new functionality and it is a major step forward in collaboration software.

Technology:

Written in Python, an open source object-oriented scripting language that is supported across a range of operating systems. The software is web based and has been designed around open internet standards so that it will integrate seamlessly with third-party applications.

Data is stored in a backend object database specifically designed for collaborative applications, and accessed by http requests. The data is delivered over XML and passed through XLST style sheets. Contains wizards for linking into external application databases that support ODBC, these include SQL Server, Oracle, mySQL and Microsoft Access.

Hardware Platform

The files in Business Collaborator are stored centrally on the server and accessed by users via their web browsers.

The system can run on Windows NT, Linux and UNIX operating systems.

Integration with Brava! (which provides server side redlining and viewing

<p>capabilities), Microsoft Index server and Inktomi (provides the ability to perform free text retrieval searching on documents).</p> <p>Integration with SQL server – which allows users to use BC’s RDB tools and store data in a third party open database.</p> <p>Integration with Active Directory and Microsoft Exchange – BC will integrate with any LDAP compliant directory service.</p> <p>Integration with PWA (Great Plains) – Once again emphasising the ability to integrate with a SQL server database</p> <p>Business Collaborator integrates with Sage.</p>
<p>Number of staff:</p> <p>Technical 13, Sales 5, Management and Admin 4.</p>

4.6/

Cadweb Ltd (Company number UK 3048450)	
Client Score 6.8	Number of users: 6000
Compagnia review: Users of Cadweb's system handed the product "the wooden spoon". Cadweb have however secured a number of clients, and they therefore have the potential to build on these relationships to develop a sustainable proposition. Cadweb's focus is on transmitting documents to ensure contractual integrity.	
Main clients: Prudential, Land Securities, P&O Developments, MOD, Usafe, Costain plc.	
Customer (user) feedback: Overall, not as positive as the brochure!	
The benefits of using BIW, supplier perspective and Compagnia review: (1) Faster Compagnia: We were unable to find any evidence to support this statement. (2) Simpler Compagnia: the user interfaces and functionality provided by other systems was considered satisfactory to most users, so again we cannot support this statement. (3) More robust Compagnia: as item 2 above (4) Certified to ISO 17799 Compagnia: we do not consider this a major advantage, clients are able to incorporate the use of collaboration systems as a matter of contract, and then apply a set of conditions to deal with disputes – all IT systems include an element of operational risk. (5) All files digitally signed Compagnia: the threat of litigation caused by system failure should compel suppliers to address this issue, Cadweb are leading the thinking.	
Technology: We were given very limited information to review. Cadweb runs Microsoft's SQL database, and is provided on the basis of an ASP model using FTP and HTTP file transfer. The system integrates with Autoview and Outlook.	

Number of staff:

Technical 9, Sales 2 , Management and Admin 4.

4.7/

Causeway Technologies Ltd (registration number 2057821)	
Client Score: 7.1	Number of users: 15,000
Compagnia review: Causeway's products range from estimating software to a variety of e-business applications. The company's collaboration system is founded upon Live Link from Open Text. Live Link has established market traction for its products in a number of industries and service sectors, and across geographies. Causeway's people combine construction and engineering with IT, and they do have a good understanding of the industry they serve. Causeway collaboration is process driven and has in-built workflow, the application does support procurement and project management functionality.	
Main clients: Bio Gen (Denmark), New York City Transit, Hong Kong Schools, Babbie (Ireland), British Land (Plantation Place), HBG (Cheshire Police PFI), Peterborough NHS Trust, HBG (Crawley Schools PFI).	
Customer (user) feedback: Comments were less favourable than expected, which we believe is because the system relies on extensive business process migration to an environment that is insufficiently flexible.	
The benefits of using Causeway, supplier perspective and Compagnia review: (1) Customisable Workflow Compagnia: workflow is a useful tool in cases where there is an easily controlled process flow; workflow can run into problems where it attempts to align business processes across a supply chain. (2) Advanced Search Capabilities Compagnia: we couldn't see how Causeway's search capability was better than those provided by their competitors. (3) Good choice of third party viewer Compagnia: ! (4) Flexibility (configuration of the system to meet exact requirements) Compagnia: the system has flexibility, but not as much (according to responses from users) as other systems. (5) Aggressive development programme Compagnia: Causeway has a strong development team and has backing from Open Text. The business also benefits from a relationship with academia so is well poised to develop its product.	

Technology:

The outline Technical Architecture for Causeway Collaboration is in three main tiers: Application servers, Database Server, Files Storage Array.

Collaboration uses application servers, which store data to mirrored file storage arrays that comprise of multiple, independent RAID protected disk arrays mirroring in real time, with metadata stored in a mirrored Oracle database.

The system integrates with Microsoft functionality via a desktop module (which allows functionality of the system to be accessed from within Microsoft windows applications) and with various CAD and ERP systems.

The System supports the storage of URLs and these can be used to access other web-based applications.

Back-office interoperability is available with a number of solutions, including: Microsoft Office (including Outlook) Lotus Notes, Documentum, JD Edwards, SAP, Oracle, and any ODBC compliant data base. This functionality has been used with a number of our key customers to link to existing CRM, accounts, and invoicing systems.

The company is developing links to asset management solutions

Number of staff (including all services provided by Causeway)

Technical 50, Sales 25, Management and Admin 50.

4.8/

Sarcophagus Ltd (Registration number 378 0350)	
Client Score: 7.9	Number of users: 7219
Compagnia review: A small company, but has nevertheless been awarded contracts that its competitors would have liked. The company's senior people are mostly from a construction background	
Main clients: Asda Walmart, Audi Automotive, Miller Construction, Stadium Developments.	
Customer (user) feedback:	
The benefits of using Sarcophagus, supplier perspective and Compagnia review: (1) One of the fastest UK construction collaboration systems Compagnia: we did not get the chance to measure this although there is great importance in speed where there is a poor internet connection. (2) Intuitive and easy to use Compagnia: endorsed by clients, but unique to Sarcophagus. (3) Reliable and resilient; unplanned down time of 2 minutes and 8 secs in 5 years Compagnia: (4) eTenderer – online integrated tendering and procurement system Compagnia: this is a strength and although not unique, does provide advantage over systems that do not provided such extended functionality. (5) Supports most file formats and many viewers Compagnia: standard.	
Technology: Web based database utilising Microsoft SQL 2000, Asp.Net, VB.Net and Java. Interoperability with other collaboration systems: Developed Doclink as a European R&D initiative for the EU funded Procure Contract. The company is currently working with several other collaboration extranet providers to establish a data exchange standard	
Number of staff: Technical 11, Sales 1, Management and Admin 4.	

4.9/

4Projects Limited (registration number: 3948233)	
Client Score: 8.3	Number of users: 13,000
Compagnia review: 4Projects has successfully developed a system that satisfies a range of blue chip clients. The company has a good mixture of construction and IT people, and has developed a product that fits in well with the industry's processes. The product's processes cover project management and procurement. 4 projects has offices in the UK, North America and the Middle East.	
Main clients: Royal Bank of Scotland, Shepherd Construction, Arup, Intergulf, Pearce Group, Birse Build, Norwest Holst, Taylor Woodrow, Sir Robert McAlpine, John Lewis Partnership, Mott McDonald, Six Continents.	
Customer (user) feedback:	
The benefits of using 4Projects, supplier perspective and Compagnia review: (1) Speed of setting-up extranet & establishing protocols Compagnia: we didn't measure this against other systems, but agree that this is an important area. (2) Ease of Use (Automating existing work processes e.g. Drawing Issue Sheets, Photo Thumbnails, Files and Folder views - all driven by database) Compagnia: good processes, but do not provide competitive advantage (3) Rich functionality (Workflow, Creating and Tendering Works Packages, Full Text searching within Documents and Drawings etc, Multi-language support) Compagnia: we have mixed feelings about established (hard-wired) functionality although as 4 Projects have a large user group and the company comprises people with extensive construction experience, they are likely to converge with sufficient industry standard processes to satisfy the needs of most clients. (4) Fully auditable LAN archive for Client/Consultants providing entire Knowledge base Compagnia: excellent development as it improves transparency and reduces hurdles to accessing information. (5) Enterprise solution (Unlimited Projects, Users and Disk storage to support Programmes of Work, Framework Agreements etc) Compagnia: this makes the product competitively priced, although our view is that the market will unilaterally move toward this revenue model.	

Technology:

4Projects' architecture was designed to be delivered via the web. The delivery model is application service provision.

The solutions use n-tier architecture with component-based business objects with SOAP/XML/ASP interfaces. The solution is scaleable via clustering and load balancing. The core database technology is Microsoft SQL Server. All data including meta-data and files are stored in the database itself ensuring robust security and delivery of customer archive solutions.

With reference to web services, 4Projects already has an API allowing third-parties to integrate directly with the extranet using SOAP/XML

Internal integration includes 4Projects Desktop, a software tool that provides extranet functionality at the operating system level. This is compatible with Windows 98 upwards and enables 4Projects and third parties to integrate extranet functionality within software applications such as MS Word, AutoCAD.

External integration includes a project to integrate directly with an Enterprise customers IBM hosted data-warehouse. Data integration involved the development of a bespoke software solution, integrated with both the 4Projects extranet and the customers own data-stored.

Two integration projects (with Peoplesoft and JD Edwards) are planned later this year with the company's Enterprise clients.

Number of staff:

Technical 7 , Sales 4, Management and Admin 4.

Appendix 5.1/ E-Business outline

Collaboration

This report is concerned with the collaborative processes (centralising and aligning business processes throughout a supply chain) that develop following the implementation of collaboration software.

The collaboration software that is used to link with external organisations is generally known as a “project extranets”.

(Intranets and company portals are inward facing and facilitate equally valuable collaborative processes - Intranets provide an electronic infrastructure to enable efficient communication throughout an organisation; Enterprise portals aim to get the right information (from all relevant business applications) to the right person (the most effective form of enterprise portal tailors information with to specific job roles, level in the hierarchy etc) at the right time (thereby reducing latency). Enterprise Portals and Intranets reduce the amount of non-productive time taken to extract information from disparate systems and they significantly reduce internal administrative burden.

Companies that have successfully implemented intranets and enterprise portals say that not only is there an immediate benefit in terms of increasing productivity, but the that systems increase transparency (enabling people to access information they otherwise wouldn't have) and they increase “community” – the creation of communities of interest that form the basis for conveying knowledge in an efficient manner).

Sustainable success comes from devising a business-social order that meets the needs of all stakeholders; project participants have differing needs, all of which are woven into the fabric of contractual obligations and goodwill.

Notwithstanding political correctness, clients want the highest quality at the lowest price, architects seek to maximise design input and contractors want as much money up front together

with the highest possible price for the contract. There is and will always be tension between organisations whether they are in “partnership”, “joint venture” or under “traditional contract”.

Despite divergences between needs, our brains have been hardwired by evolution to cope with group living. Internet technology challenges us by providing a new channel for communication which is itself evolving to provide us with a truly virtual world (3d images, sound, and even touch!) which opens up new possibilities including the formation of groups that could not (economically) combine without the technology. The hardwiring in our brains compels us to seek group participation (community) and the internet’s growing transparency serves this potential as it increases the number of community options.

The construction industry’s resources are disparate, and its supply chain fragmented – hence the demand for collaboration systems.

Collaboration systems can only be wholly effective when the level of communication between peers aligns with the high level of trust associated with sending communication and the trustworthiness of the response!

The World Bank has a startling way of summarising the value of trust: “Trust is one of the most powerful factors affecting a country’s economic health. Where trust is low, individuals and organisations are more wary about engaging in financial transactions”.

Information

The question is, will communication improve with new technologies, or will we all drown in information and therefore be unable to communicate properly?

Information production is growing at about 50% each year and seems to expand to fill the storage space available; bearing in mind where we are heading relative to increasing memory capacity this will create new and highly challenging issues.

IT in general is a breeding ground for the creation of information, and the trends are startling. In the early 1990s, a computer workstation cost on average £12,000, the current cost is under £1,000 and by 2010 it will be under £100.

Although we all benefit from e-mail, it has added a new layer of inefficiency in our work as we trawl through information sent (often not for our direct attention) and quickly delete spam. In December 2001, spam was just 8% of e-mail, by December 2002 it had risen to 40% and is still climbing - the cost of dealing with this is a new cost we didn't have prior to the internet, so clearly there are some trade offs unless we determine ways to enhance the sophistication of our IT systems and related processes. The other threat from e-mail, that of security, is considered so serious that the UK Defence Agency now offers free anti-virus software to prevent the propagation of computer viruses.

Whatever volume of information is sent to us however, we still only have the capacity to deal with an average of 7 pieces of information – Seven Sins, Seven Habits of Highly Effective People, Seven Wonders of the World, Seven Ages of Man and three others for the reader to choose!

According to Yahoo, next to e-mail, the thing that most people do online is look for information. It seems that we are all gorging on an excess diet of information and readers should beware that much of it is just sales patter masked in the form of white papers.

The days when 10% of the people in a company did 90% of the thinking are gone, and we are on the road to 90% of the company doing 100% of the thinking (90% because there are always 10% “heading for the exit”!). Although some interpret this to mean that organisations will have flat structures, the need for hierarchical control will remain particularly as there is an increasing need to manage the processes associated with more portable knowledge.

Digital Nervous System

There is a clear demand for transparency throughout organisations and throughout supply chains; upper management is increasingly looking beyond middle management as it seeks a clearer, less skewed, picture of the workforce.

Enter the digital nervous system, which is a development that will progressively transform business, not because it is a technology, but because the technology modifies the ways in which people communicate, and therefore work.

The digital nervous system can be created by:

- Channelling information electronically through a centralised managed collaborative system.
- Creating cross-departmental teams that can communicate virtually in between regular face-to-face meetings.
- Converting every paper process to an electronic process – reducing latency and freeing people to work on more important tasks.
- Trading information for time. Reducing cycle time by using digital transactions with suppliers, transforming every business process into just-in-time delivery.
- Creating a digital feedback loop to improve the efficiency of physical processes and improve the quality of the products and services created. Every employee should be able to track easily all the key metrics.
- Using digital systems to route customer complaints immediately to the people who can improve a product or service.
- Using digital communication to redefine the business and its boundaries - become more adaptable both in terms of resources and scale of opportunities sought.
- Making extensive use of processing capability – shifting knowledge workers into high-level thinking about products, services and profitability.
- Analysing sales data to find patterns and share insights, understanding overall trends and personalising service for individual customers. Making use of digital tools to enable customers to help themselves.
- Looking for opportunities for market transparency, i.e. reducing the number of middlemen.

In order for the digital nervous system to function, and for us to maintain control over information, we need to establish ways to manage the beast.

The need for improved control has spawned collaboration software, a vital IT ingredient because it channels information in a way that aligns with evolving processes, in other words it is a centralising controlled approach rather than a distributed uncontrolled approach (like e-mail for example).

The controlling nature of collaboration software provides a focal point to enable project communities of like-minded people, and or those working to common objectives, to work together without being frustrated by organisational boundaries and across geographies.

Community

Communication centralisation facilitates an enhanced social network effect, which releases knowledge to peers. The internet has already proven itself with personal trading (e-bay), online dating and re-forming social networks from school days (Friends Reunited). This enhanced transparency extends to encompass an increase in knowledge utilisation.

The connected business demands a change in the way the organisation is designed; these are the main connection points that can be supported by collaboration software:

- Knowledge sharing: best practices, making use of expertise in operational areas, sharing product/ service/ geographic/ market know how.
- Resource links: sharing physical assets, for example R&D equipment.
- Negotiating power links: producing economies of scale through common purchasing.
- Strategic links: combining resources to deal with an external issue
- Vertical integration: improving the flow of products/ services to improve operating efficiency
- New Business: creating new businesses by combining know how from units through teams, internal joint ventures or other alliances.

In order to manage this new organisational structure, managers will need to learn how to maintain an element of control over the enhanced networks of people both within and external to the organisation. This will involve identifying the various types of network participant and managing on a basis beyond the concept of line managers we currently use. Hierarchies will change and as transparency increases, the skills of management and those being managed will also change.

Productivity

Economists search for continuous productivity growth, but are often frustrated by the “productivity paradox” – the decline in productivity growth despite massive investment in new technology. Over the past 10 to 15 years, IT investment has seen extensive year on year growth and yet overall productivity growth has lagged behind investment.

The reality is that the transformation process (mostly human cost) takes considerable time thereby incurring cost to offset benefit.

Companies shouldn't be fooled by the notion that IT investment alone will increase productivity; a 2002 report found that there was a positive relationship between IT investment and productivity, but that it applied only to certain sectors and was heavily qualified. In other words, IT investment is not enough, companies must take people and processes along with the investment otherwise there will be trouble.

Despite all the time and money that companies pour into change programmes (associated with IT implementations) the stark reality is that few companies ever succeed in properly reinventing themselves. For example, IT implementations often fail to reach the required standard and usually activate only a proportion of the available functionality. This is because people often fail at transformational learning, they rarely get to the point where they are eagerly challenging deeply held assumptions about a company's processes and, in response, thinking and acting in fundamentally altered ways. Most people end up doing the same thing in superficially tweaked

ways. What is vital is that people are taught how to learn (within the corporate environment) and that they are given the resources they need to complete the course.

A degree of technology consolidation is therefore vital to enable us to determine how to make use of new systems before we rush off to the next big thing.

Collaboration software is an important part of technology consolidation because it acts as glue for the complex adaptive systems that have formed through internet technologies.

(Complex adaptive systems are made up of independent but dynamically interacting elements that evolve their optimum performance by constant learning, changing and adapting to their environment).

Knowledge

Looking at continuous dynamic change & adaptation in the context of the connectivity and transparency provided by collaboration software leads to a number of exciting conclusions. Organisations will be better positioned to leverage their own tacit knowledge, together with that from their supply chains. They will be better able to combine academia (across its full spectrum from humanities to pure science) with business.

The theory is that as business value increases through the crystallisation of knowledge, so the ideas and brainpower of a company become the value of the company with minimised (and outsourced) assets at the edge.

Realising knowledge as business benefit sets the stage for the learning organisation, which advocates workers and managers learning from each other, from customers, competitors, suppliers and the outside community and sharing that knowledge in pursuit of competitive advantage.

Knowledge is vested in areas throughout a business and its supply chain, and collaboration software can support the process of determining where knowledge is. This breaks through convention to enhance the rate at which transparency grows.

The subsequent clustering of knowledge gives rise to “networks of practice”, i.e. where people have practice and knowledge in common. These will at times compromise corporate boundaries as people will wish to be part of communities that may not align with the interests of their employer.

This extended reach reduces design and operational costs as organisations absorb and re-use knowledge on a more pro-active and efficient basis. The amount of re-learning will be lessened.

But knowledge is only a part of the story; there is also a need for creativity that leads to realisable innovation.

Innovation is maximised when people have trust in an organisation’s decision-making processes, and when they are working to a properly defined goal.

The knowledge infrastructure, and process infrastructure afforded by collaboration software enable people to have an enhanced project connection, complimenting face-to-face meetings.

Encouraging a more collaborative working environment fosters creativity from which innovation flows freely because the differing needs of project participants are better understood.

We should remember however that for all the advances in IT, direct human contact is still the most efficient way of getting groups of people to perform. There is as yet no substitute for “pressing the flesh”, the occasional exchange of pheromones. In addition, sociologists say that the internet enables people to adopt new social rules meaning that we have some more learning to do until we can say that IT has become entirely infrastructure.

We have already begun the knowledge-industry revolution, and with it will come enormous change comparable to the changes that occurred during the industrial revolution. Economic

revolutions can take decades so we should bear in mind not only where we are on the cycle, but how long it will take.

Transformation

During the 1800s, the world was changed by the introduction of the railway network, which transformed social structures. Likewise, the internet will facilitate an equivalent (Knowledge) Infrastructure that will make knowledge more portable, and therefore give rise to social and business change once again. Continuing the analogy, as with the rail network, the internet will have maximum impact only when it has become an environment in which standardisation prevails and thus IT becomes ubiquitous.

As for where we are right now, the cost of IT needs careful consideration, as Nike, WS Atkins and Hershey will testify as (collectively) they lost over £250 million as a direct result of problems with IT systems. According to the US Commerce Department's National Institute of Standards and Technology, software bugs alone cost US companies £45 Billion per annum by reducing productivity and disrupting operations. This indicates the price of getting it wrong, whereas the value from getting IT right can leapfrog a company ahead of its competitors.

For a measure on how the internet is doing, the United Nations Conference of Trade and Development (November 2002) said that by 2006 in Europe 20% of all B2B sales will be traded online. Astonishingly, GE Capital has increased their win rate for substantial contracts (£50m plus) by using internet based processes that support the sales process. GE's clients said that the sales process was so streamlined and transparent that a high level of trust evolved quickly giving GE competitive advantage.

The UK is catching up with the US in implementing e-business initiatives meaning that we are in position to not only talk to local software suppliers who understand our market, but we can also use the technology to leverage competitive advantage in a global context. The e-business gap between the US and the UK is now an average of 12 months, from 18 months last year. In terms

of collaboration systems, there is no gap and UK suppliers are finding there is a market for their services in the US and elsewhere.

UK companies looking to inject entrepreneurial spirit into their management must analyse how best to make use of internet technology, these are the main points:

- Look at how competitors are responding to the market, and particularly where they have secured competitive advantage.
- Assess business processes, and apply a process of continuous improvement.
- The business can only fully respond to e-business by adopting a more outward facing approach, including the need to adopt collaboration systems that centralise documents and align processes that to a certain extent ignore company boundaries in favour of working collaboratively.
- Audit IT systems for their potential, and look at web services solutions where there are inward facing systems that cannot be replaced.
- Establish opportunities (within with context of the core offering) that can be resourced using internet technology.
- Rigorously assess your supply chain and customer and partner relationships, and do it again and again because as the commercial world continues to change, opportunities for enhanced profit/ reduced cost will evolve continuously.

People and the Internet

Some organisations are already making quite effective use of what is termed “business to employee” processes, with the three main areas as follows:

- “Hard” cost savings from replacing paper processes used for the administration of human resources, procurement of goods and services and staff training with cheaper electronic equivalents. People spend most of their waking hours at the workplace during the week; we should therefore look to improve their working environment.

- Increased worker productivity when information on best practices, internal job vacancies and training opportunities is conveyed via an employee portal or intranet. The most productive people are those that have a passion for their work. This alone is a compelling argument for the improvement of systems.
- Making life easier for employees by streamlining and web enabling expenses claims, accuracy of pensions data, rota scheduling. We should remember that most people blame organisations for subjecting them to deadening routines while demanding they comply with dehumanising conformity. The message is simple - take out tiresome non-productive work.

The more leaders can connect with all employees, thereby making them feel a part of the team and increasing their sense of worth, the more productive companies will become as their main asset, their people, are energised from within. The reach provided by collaboration software helps to increase people connectivity at all levels, and it helps to apply disciplines ranging from maintaining spend- discipline, to following operational procedures.

As companies strive to build on their intellectual capital held within their workforces, the value of the corporate e-learning market is set to rise drastically over the next few years.

E-Learning reduces training costs dramatically, and increases the availability of improvement programmes to employees throughout the organisation.

Research and Development

The construction industry has suffered from inadequate research and development investment for time immemorial, when compared with R&D investment in other UK industries construction (less than 1%) is clearly in need of sustainable R&D growth for the next few decades:

Aerospace and Defence 6.8%, Automotive 5.0%, Chemicals 2.5%, Construction 0.9%, Electronics 3.1%, Engineering and Machinery 1.9%, Health 6.6%, IT Hardware 7.5%, Leisure 4.1%, Pharmaceuticals and Biotechnology 14.1%, IT software 7.0%, Telecoms 1.2% and Transport 1.5%. (Source Financial Times, October 2002).

We cannot however escape the fundamental question, whom and what is business for? As business evolves to deal with the internet, and a company's assets increasingly found in its people (less so in its buildings and machinery) we are challenged both by the need to understand the dynamics leading to change, and how best we should respond to it. As companies become more vulnerable to employees, they will respond with defensive measures that will radically alter the contractual relationships currently in play.

The caveat to this change is that it will take some time to occur, and in the meantime there is the here and now to address – how to upgrade the UK's construction industry from within.

Concurrent with the need to deal with change as a result of new technologies, there is the need to ride the economic cycles that await. Regrettably, directors are often caught having high stock levels and rapid expansion plans under way when they should have been battening down the hatches. When the economy slows, R&D is one of the first casualties, along with the tacit knowledge that resides within the people who are "let go". Whatever is ahead, we should be prepared for it and respond with a more positive pro active approach.

Appendix 5.2

Measurable direct savings potential				
Notional £1m project value, including client and supply chain costs				
Item	% cost	Lump sum cost	% saving	Reduced Cost
Photocopying (incl. large drawings)	0.35	3500	-60%	1400
Administration (improved filing!)	0.50	5000	-50%	2500
Postage	0.05	500	-50%	250
Printing	0.20	2000	-50%	1000
Storage and associated costs	0.10	1000	-75%	250
Courier	0.10	1000	-80%	200
Information ref project at end / CDM	0.30	3000	-75%	750
Reduced phone bills, including mobile	0.30	3000	-30%	2100
Reduced fax bills	0.10	1000	-30%	700
Cost of proportion of project meetings	1.00	10000	-20%	8000
Totals	3.00	30000	-42%	17150
<i>Savings equate to 1.28% per £1m</i>				

These savings are potential savings, and to achieve them requires a disciplined approach not only relative to the use of technology, but in terms of working practices.

As the amount of information available increases, people have a tendency to over-burden both themselves and colleagues with excess information.

It is vital therefore that collaboration systems are treated as Knowledge Infrastructure, i.e. that it is a method of making quality information more easily accessible thus reducing (not increasing) administrative burden.

Appendix 6.3

Measurable consequential benefits potential – data points
Notional £1m project value, including client and supply chain costs

Item	Notes	Conclusions
Project acceleration: Design Procurement Production Operation	For every 52 weeks of production (construction industry), there are on average 10 weeks of design and 6 weeks of procurement. By reducing design time by 15% and procurement by 10%, the implication is an overall saving of approx 2 weeks. During production, data from users indicates that, on average, time is reduced by 5% . During the lifespan of the building, efficient access to information will have considerable value to the owner.	Total acceleration of 4 weeks in 52 on a £1m project with an allowance of 14% for client and supply chain overheads / prelim costs implies a saving of 4/52 times £1m times 14%. This gives circa 1% benefit to the project client. The acceleration is 4/52, which is 7.6%.
Reduced abortive work	Abortive work is complex to assess because it is often absorbed within an organisation determined by contractual obligations. However, such costs are ultimately manifest by (a) increased probability of litigation (b) project delay (c) loss of relationship with company and potentially its associated supply chain.	We estimate that the cost of abortive work is 1.5% of project cost, and that abortive work is reduced as communication improves. Our analysis suggests a saving range of 0.2% to 0.3% of project cost, 50% attributable to client costs.
Increased supply-chain transparency	Increased transparency enables clients to more effectively adopt alternative procurement options. Acceleration in conveying supply-chain related knowledge should lead to better and timelier decisions. Clients can more easily determine whether the design programme aligns with production, and whether or not companies further down the supply-chain have been paid in accordance with the contract.	Information empowers. To what extent this crystallises into measurable savings is very much dependent on individual events. For example, where we have improved access to specialist quotations, this will lead to a reduction in project cost (sometimes to the detriment to the contractor for example). We estimate that increased supply chain knowledge reduces project costs by 1%.
Better data capture	In addition to improved filing, better data capture cuts out a considerable amount of non-productive time whereby team members have more direct and searchable data. Norwich Union offer users of BIW's system a reduction in the cost of latent defects liability insurance on the basis that they have calculated the reduced risk associated with	We estimate that the average team member, whether they are an architect, site agent, surveyor all spend approximately 5% of their time looking for information. If we assume that 65% of a project cost is in human resources, and that 25% of the human resource involves roles that benefit from

	improved communications.	collaboration software, then a reduction of 30% in non-productive time relative to inefficient "knowledge" storage equates to 0.24% of project cost.
E-Mail management also included in pure qualitative results.	<p>E-Mail is now almost as much a burden as a benefit.</p> <p>We now have too much information and urgently need to find solutions to this.</p> <p>By conveying information through collaboration software, we benefit in a number of ways: (a) project information is held centrally, not dispersed in unmanaged e-mail accounts</p> <p>(b) document transmittals are more easily managed, thereby increasing accountability and (c) you cannot spam collaboration software.</p>	<p>Improved communication processes means reduced project risk.</p> <p>It is estimated that, on average, 1 hour is wasted each day dealing with e-mail filtering.</p> <p>Collaboration software does not prevent the overall problem, but it does cut out the need for filtering in the context of a project centric perspective. Users state that this provides tangible benefit in terms of less non-productive time. If we equate this to be _ of the average 1 hour wasted, then this could be as much as _ hour average for every team member, bearing in mind that human costs are approximately 60% of project costs, and 25% of the 60% represent the project roles that use e-mail. From this we conclude a tangible saving of 0.5%.</p>
Project financing costs	Acceleration leads to a range of benefits, including a reduction in costs associated with project financing.	<p>Based on our research, where collaboration systems are used on projects, the acceleration has an average potential of 7.6%. Depending on the finance agreements in place, interest rates and even whether the client is using borrowings to finance, the saving in / or capacity to use cash elsewhere to earn leads to further cost savings for the client. This results in a savings range from 0.02% to 0.05% depending on the method of funding, loan to value ratio and interest rates.</p>

Appendix 5.4

Measurable consequential benefits potential - measured
Notional £1m project value, including client and supply chain costs

Project events. Typical roles for project. Example is £5m contract involving a full design team with client participation.	Number of Participants	Meetings	Non-productive time – at 25%	Time involved in total activity	Cost using an ave. hourly rate of £40.	Reduction in time spent	Value of time for reallocation
Activity	people	no.	hours	hours	£	%	£
Preliminary catalyst meetings	2	2	1.0	4	160	0.3	40
Develop project brief	2	3	3.0	12	480	0.8	120
Feasibility study and report	3	2	4.5	18	720	1.1	180
Project finance	3	3	6.0	24	960	1.5	240
Land acquisition	8	10	8.5	34	1360	2.1	340
Planning consent conditions	4	3	30.0	120	4800	7.5	1200
Project strategy	2	2	3.0	12	480	0.8	120
Project administration process	2	2	10.0	40	1600	2.5	400
Consultants briefs	6	2	3.0	12	480	0.8	120
Project programmes	4	2	2.0	8	320	0.5	80
Select project team members	14	16	25.0	100	4000	6.3	1000
Establish management structure	2	2	2.0	8	320	0.5	80
Co-ordinate design process	8	12	48.0	192	7680	12.0	1920
Appoint consultants	14	8	33.0	132	5280	8.3	1320
Insurance and warranties	3	2	3.0	12	480	0.8	120
Select procurement system	4	1	1.0	4	160	0.3	40
Arrange tender documentation	14	2	10.5	42	1680	2.6	420
Contractor pre-qualification	26	12	6.0	24	960	1.5	240
Evaluate tenders	14	6	4.5	18	720	1.1	180
Contractor selection	8	4	4.0	16	640	1.0	160
Contractor appointment	4	2	3.0	12	480	0.8	120
Organise control systems	4	1	1.5	6	240	0.4	60
Monitor progress	14	6	31.5	126	5040	7.9	1260
Arrange / manage meetings	18	12	96.0	384	15360	24.0	3840
Authorise payments	18	20	90.0	360	14400	22.5	3600
Set out reporting systems	4	Inc	1.5	6	240	0.4	60
Total co-ordination	18	Inc	60.0	240	9600	15.0	2400
Issue health and safety procedures	18	Inc	18.0	72	2880	4.5	720
Address environmental aspects	18	Inc	13.5	54	2160	3.4	540
Co-ordinate statutory authorities	8	6	24.0	96	3840	6.0	960
Monitor budget and variation orders	18	18	101.3	405	16200	25.3	4052
Develop final account/s	18	8	54.0	216	8640	13.5	2160
Arrange commissioning	18	4	23.5	94	3760	5.9	940

Handover	18	6	24.0	96	3840	6.0	960
Advise on marketing and disposal	2	Inc	1.0	4	160	0.3	40
Maintenance manuals	18	8	54.0	216	8640	13.5	2160
Plan for maintenance period	4	Inc	1.5	6	240	0.4	60
Develop maintenance programme/ training	10	2	6.0	24	960	1.5	240
Plan facilities management	4	Inc	1.5	6	240	0.4	60
Arrange feedback monitoring	4	Inc	2.0	8	320	0.5	80
Totals	N/A	137	815.8	3263	130520	204.0	32632

The above table is an outline of the “hidden” cost of non-productive time associated with an element of project management and design activity. We estimate that the cost of non-productive time amongst professional and client team members – with some interaction with the production supply chain – amounts to 25% of the cost of their time.

Fee scales reduce as project scale increases, nevertheless, the average saving on professional fees should amount to approximately 10%. In addition, collaboration systems increase organisational reach meaning that it becomes economic to utilise more cost-effective (off-shore) resource and this trend is now underway as engineers, architects and cost consultants seek competitive advantage by deploying these assets.

Professional fees have an average aggregate cost range of 8% to 12% of total project value; the reduction in cost of 10% makes for a convenient average 1% reduction on overall project cost that will (eventually), as a result of market forces, convey directly to the client as a benefit.

Bearing in mind the “volume” of communication that exists throughout the production supply chain (i.e. the contractor and his subcontractors and specialists) we consider that the total measurable saving achievable from the professionals is magnified by a factor of between 2 and 5, indicating that the savings potential to overall project cost is therefore a further 2% to 5%.

The tables indicate that the savings range should pan out at between 3% and 6% over time. We expect to see these savings work through to the client over a period of between 1 to 3 years, depending on the success of implementations.