

## Summary of system description from first round interviews

### Introduction

The descriptions of the views of the project in this document have several parts – but only a few have vignettes.

1. A CATWOE. This is the main elements of the description made up of 6 elements

*Customers*

*Actors*

*Transformation*

*Weltanschauung (world view)*

*Owner*

*Environmental constraints*

2. A vignette – a brief account of circumstances that this description may arise.
3. A root definition. The elements of the CATWOE compiled into a description of a system
4. Three evaluative measures

*E1 Efficacy – does the system work in its own terms*

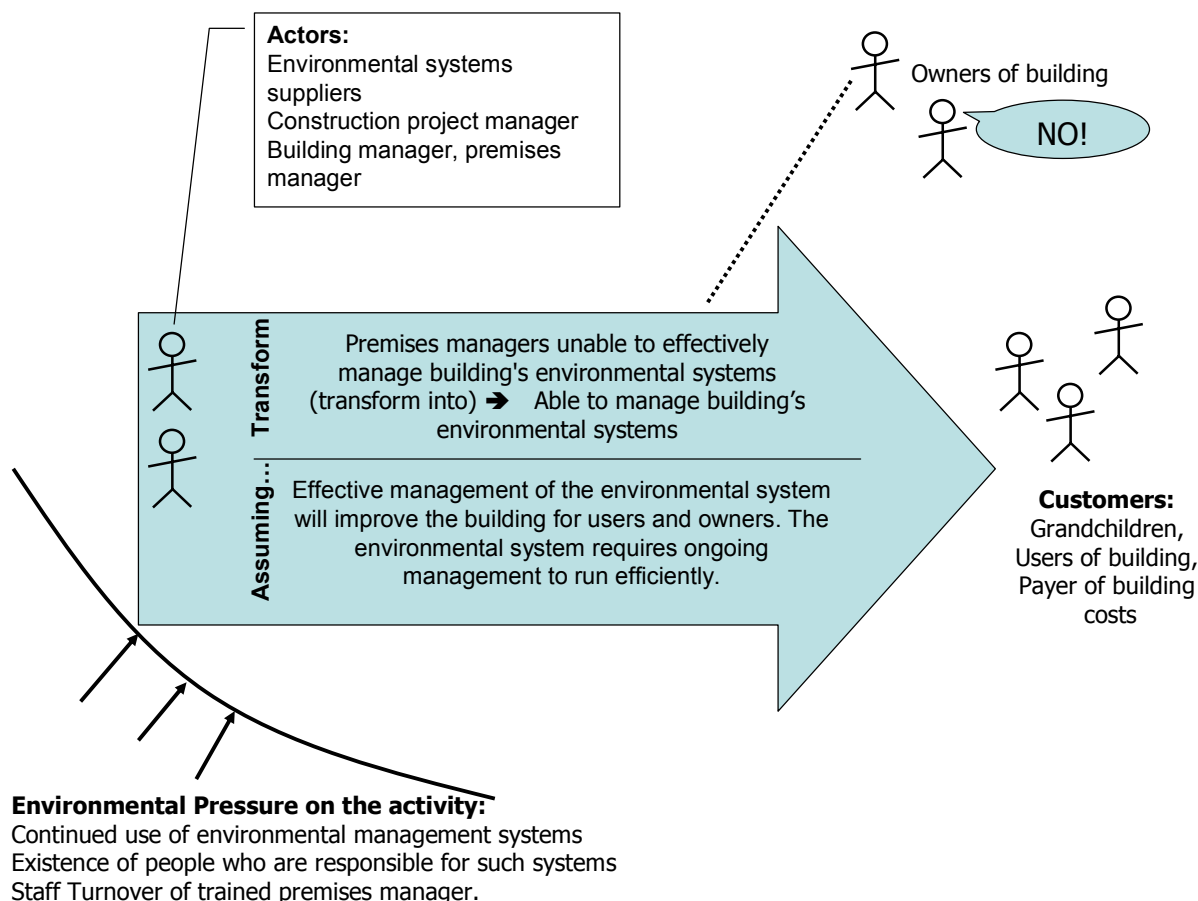
*E2 Efficiency – does the system use minimum required resources*

*E3 Effectiveness – does the system do anything useful*

## ***Index of CATWOEs***

- 1) Premises managers unable to effectively manage building's environmental systems (transform into) → Able to manage building's environmental systems
- 2) Lack of project wide definition of sustainability → Accepted project wide of sustainability
- 3) No specific legislations/regulations on sustainability by the UK Government → Specific legislations/regulations
- 4) Waste generation → waste minimisation
- 5) Loosing knowledge/experience between projects → retaining and reusing that knowledge/experience on new projects
- 6) Informal knowledge/experience sharing → formalised and recorded knowledge/experience sharing
- 7) Sustainability tends to happen only on landmarks/flag shipped projects → incorporating sustainability into all day to day construction practices
- 8) Research/innovation in construction sustainability more re-active than pro-active → more pro-active research/innovation
- 9) Poorly organised/directed adversarial project teams → Cohesive teams with a sense of direction/purpose
- 10) Contractors estimating poorly the costs of innovative practice → improved estimating.
- 11) Inter-relationship of sustainability issues poorly understood → inter-relationships better understood
- 12) Little knowledge about sustainability impact of activities of suppliers → Comprehensive knowledge about sustainability impact of activities of suppliers
- 13) T – SMEs existing in a KM impoverished state → SME's gaining advantage from KM techniques/technologies.
- 14) T – Working environments not conducive to acquisition of new knowledge → environments where new knowledge is acquired/assimilated
- 15) T – Being seen to be green (for marketing purposes) → Actually being green (environmentally and socially sensitive)
- 16) T – An expectation of certain 'norms' for given building types on the part of owner/occupiers → Changed expectations more in line with a sustainability agenda
- 17) T – Prompts/guides as a tool for minimal compliance → Prompts/guides as a tool/springboard for learning
- 18) T – Poor cost benefit analysis with respect to sustainable construction solutions (poor whole life costing) → improved cost benefit analysis
- 19) Contractors not knowledgeable about designer's intentions and their meaning → contractors knowledgeable
- 20) Designers have insufficient regard to buildability → Designers better understand the problems of contractors
- 21) Information that explains the design rationale not available to the contractors → information available.
- 22) Knowledge lost between projects → Knowledge retained
- 23) Innovation is seen as a Risk → Innovation seen as business opportunity.

1) A technological system to enable premises managers to better manage a buildings environmental systems in order to improve the buildings operating conditions, and reduce the buildings overheads.



In constructing a building the environmental systems are installed as standard components and need adjusting to the particular needs of the building they are embedded within. While some of this configuration is undertaken during installation, the ongoing adjustment to changes in conditions and fine tuning over time are often left to premises managers employed either by the clients in the construction project, or the group who pay the ongoing building costs (e.g. a tenant). These systems are often difficult to effectively manage without effective training, and subsequently the systems are often run sub-optimally. Such sub-optimal operation reduces the operational efficiency of the building, and degrades the environment for users of the building.

The training of such premises managers and documentation of the environmental systems is generally left until the project is very near completion and can often be rushed when construction falls behind deadlines. This can lead to those people responsible for the environmental systems to be ill equipped for the task, neither appreciating its importance and value, nor understanding the systems controls. Furthermore there is a worry that the training in such systems is often poor and

## Vignettes and CATWOEs– First Round

inadequate to the demands. In particular quality may be poor as documentation remains a chore which few people enjoy.

An example of this problem was found within an Egan demonstration project where a building services company had built a sophisticated environmental control system which it turned out everyone had left on default settings for two years. This only became apparent when an energy audit was carried out two years down the line and the buildings energy bills were out of the expected range.

### ***Root Definition:***

*A building owner controlled system to enable premises managers to more effectively manage the environmental systems of buildings in order to increase their efficiency and reduce the buildings environmental impact thereby reducing the operating costs for the owners*

*E1= That building costs are reduced.*

*E2= That the cost reduction offsets the cost of the systems use.*

*E3= That effective building management reduces costs and environmental impact*

**Vignettes and CATWOEs– First Round**

2) DROPPED

**3) THIS IS BEYOND THE SCOPE OF THE C-SAND PROJECT**

C = Grandchildren, construction industry supply chain

A = UK Government, Construction industry researchers, Academia

**T = No specific legislations/regulations on sustainability by the UK Government**

**→ Specific legislations/regulations**

W = Sustainable construction largely ignored due to perceived cost implications and therefore, potential benefits to the industry and wider community are lost. Legislations/regulations can compel and drive the industry towards sustainable development and sustainable construction.

And/Or

Every building or civil engineering project has to go through the design and construction phase before come into its final shape. The whole process of design and construction includes many decisions and activities which could affect sustainable development. In order to minimise the affect, one of the options is to introduce specific legislations and regulations.

O = UK Government

E = Current practices and culture within the construction industry, overall community view, research activities

The construction industry, considered to be very reactive industry, would not move quickly towards sustainability due to many reasons such as high risk, limited time, tight budget, lack of enforcements, etc. Construction industry could lean more towards sustainable practices due to new emerging trends within the industry, and pressure by the wider community. Despite many alternative efforts

*Potential change of T*

*T = Need for [targeted | precise | more] UK government policy on sustainability - >*

*Need met*

**Root Definition:**

*A Lobbying system, owned by ? to [facilitate | Negotiate | Suggest] UK government legislation by means of [Research| dialogue] in order that [Costs are accepted | Risk in undertaking sustainable practice is reduced | Change is imposed]*

*E1= That more targeted government policy is achieved*

*E2=That the opportunity cost to sustainability offsets the effort undertaken in gaining such policy*

*E3= That the sustainability of UK construction practices improves*

4)  
Sub-contractors

**T = Waste generation → waste minimisation**

W = The UK construction industry is seemed to be one of the industries with high volume of waste. If material is managed properly on the construction sites, the cost reductions would be realised. It would also result in time saving on sites and less environmental impact. This would be then passed over to the whole project.

And/Or

Construction activities are generally expected to produce lots of waste. On the other hand, the fact is the amount of waste produced on a construction could be reduced drastically only bringing waste management plans.

O = Clients, contractors, sub-contractors

E = Tight schedule, limited budget, risk related to innovations

In order to make construction industry free from waste, many serious actions must be taken on construction sites. Many efforts have been done to reduce waste on site. One of these is that the industry has moved towards waste management seriously under the flagship of making construction more sustainable. The industry with the help of researchers could come up with many solutions to minimise this waste on the construction sites. The industry could follow a suggested mechanism to dispose off unwanted construction material on site including using, reusing, recycling, and finally disposing off with care. The industry has now moved to pre-cast and pre-assembly concepts, constructing building components off site in a factory with high quality and standards and reducing the waste at the same time.

***Root Definition:***

*A system owned by the construction projects clients, contractors and sub-contractors that will enable them to minimise the production of waste on the construction site by means of [reuse | recycling | disposal with care] in order to reduce the impact of the construction project on the planet.*

*E1=The degree of reducing in waste.*

*E2=That waste reduction is considered profitable relative to effort undertaken.*

*E3=That waste reduction minimises impact upon the planet.*

## Vignettes and CATWOEs– First Round

5)

C = Grandchildren, Clients, Consultants

A = Clients, Consultants

**T = Losing knowledge/experience between projects → retaining and reusing that knowledge/experience on new projects**

W = Much knowledge/experience is lost when a project is completed because project team disperses and team members get involved on other projects. Therefore, there is a requirement to capture these knowledge/experience before the team disperses through project review/feedback etc. which will result in refinements of design and construction methods of new projects, maintenance of existing facilities, and preventing ‘re-inventing the wheel’ scenario.

O = Project teams

E = Time to do review/feedback, tools to do review/feedback, cost involved doing review/feedback, benefits derived from review/feedback justifying doing it in the first place, pressure of new work/job mitigates against doing review/feedback. That individuals will make use of previously captured experience in new projects. That knowledge and experience can be captured effectively.

### **Root Definition:**

*A client and consultant owned system to capture the knowledge and experience from participants in the project, by means of an appropriate “knowledge capture technique” such that the experience may be stored and presented subsequently, in order that subsequent construction projects can learn from previous experience.*

*E1= The quantity of knowledge reuse improves*

*E2= That the effort and cost introduced in using the system is offset by the sustainability benefits in future construction projects (note the dependency on future projects in this E2)*

*E3= That the overall sustainability of future construction projects is increased.*

## Vignettes and CATWOEs– First Round

6)

C = Employees/Staff, Employers

A = Employees/Staff, Companies' Management

**T = Informal knowledge/experience sharing → formalised and recorded knowledge/experience sharing**

W = A company and its staff will be benefited through the wider dissemination of shared knowledge/experience of expertise and other skilled employees. And also by doing this, the company does not lose anything when people leave the company. Therefore, it might be more beneficial by having this sharing and dissemination formalised and recorded, which could be referred and reused by the whole company.

O = Employer/Company

E = Willingness of employees to do it, existence of suitable culture (e.g. physical, social, etc.), using incentives/recognition as drivers

### **Root Definition:**

**(AS ABOVE?)**

*A company owned system which enables employees and company management to formalise their information and unrecorded experience and knowledge sharing in order to gain general benefit through the wider dissemination of experience and reducing in the loss of knowledge.*

*E1=Accuracy of formal knowledge against informal knowledge. Effectiveness of impacting knowledge formally. Effectiveness of capturing informal knowledge.*

*E2= Costs (Formalising K, Storing K, Impacting K)+Benefits < Costs (informal approaches) +Benefits*

*E3= That future projects employ more techniques known by staff thereby improving ongoing construction.*

7)

C = Grandchildren, local community, clients/owners

A = Whole industry, government, community, clients

**T = Sustainability tends to happen only on landmarks/flag shipped projects → incorporating sustainability into all day to day construction practices**

W = Flag ship projects get more importance and recognition in terms of incorporating sustainable construction issue. But in order to realise the full environmental, social and economic development and benefits of sustainable construction, these issues need to be bringing into practice throughout the construction industry on a daily basis.

O = Government, Construction Industry, Clients

E = Money, technology isn't developed enough to make it viable on a day to day basis, project duration and budget, industry leaders are prepared to take a lead, clients are prepared to take a lead and risk. *That such a system will be used to improve the sustainability of future construction projects*

***Root Definition:***

*An industry, government, community and client run system to which will engage discourse among construction professionals that will enable continuing practice from experience gained in working in landmark projects, and engender the application of the sustainability issues learnt, by means of an effective reporting mechanism, and effective promotion mechanism.*

*E1= The lessons from landmark projects are being reused.*

*E2= The cost of the systems in engendering such practice is beneficial.*

*E3=That future run-of-the-mill construction projects are more sustainable.*

8)

C=Grandchildren, construction clients/users of sustainable facilities

A=Government, construction research bodies, industry practitioners

T=**Research/innovation in construction sustainability more re-active than pro-active → more pro-active research/innovation**

W =Research/innovation currently happens mainly in response to explicit requirements from clients. Pro-active or speculative research/innovation in the sustainability arena is risky due to limited potential return on results. Assumption that a climate where improved return on investment is likely can be created

O =Government

E =Changing perceptions/attitudes towards sustainability; overall cost/competitiveness implications

Research and innovation in construction are primarily driven by the direct requirements of clients. Designers respond to challenges made in the context of secured project work safe in the knowledge that they will be remunerated for their efforts. Speculative research and innovation on the other hand are regarded as risky because money can be lost developing techniques and solutions nobody wants.

Government can create a situation where sustainability is ‘built-in’ to every new construction project through legislation. Such a move would create a market for new technology and techniques in sustainability, thus reducing the perceived risk of speculative research/innovation. This would have to be balanced against the potential for driving up construction costs, which could damage domestic construction businesses and make inward investment in the UK less attractive.

***Root Definition:***

*A system to engender a more proactive approach to research and innovation within the UK construction industry by means of incentives [legislative, Cost] such that new practice to improve sustainability is invented*

*E1=The pro-active research is undertaken by construction companies.*

*E2=That the benefits of such research are seen in reduced costs and increased profits in the sector.*

*E3=That UK construction is more sustainable relative to present costs through new innovations.*

9)

C Clients, Designers, Contractors

A Designers, Contractors

T **Poorly organised/directed adversarial project teams → Cohesive teams with a sense of direction/purpose**

W Construction project teams often end up having a gulf of understanding and aspiration between the designer and contractor elements. This manifests itself in poor communications, management and overall performance in many instances. More cohesive teams would improve performance and relations across the board.

O Designers, Contractors

E Existence of forms of contract/working practices that allow for more cohesive teams. Willingness to entertain the idea that it is a win/win process.

Current working practice and attitudes within construction often tend to lead to project teams with poor internal relations. The designers' interpretation of the clients' desires for a project fail to penetrate the team to the level of individual contractor operatives on site. Thus there is no 'buy-in' to the project aims and aspirations and no sense of place or of belonging to a wider group than those immediate colleagues seen every day. The common practice of teams splitting up at project completion tends to exacerbate this phenomenon by forcing people to forge new relationships for every new project.

Efforts to change attitudes within the various 'factions' need to be made such that a project can develop an identity of its own, one that all involved can understand and take on board. Initiatives such as partnering could play a key role by allowing longer term associations to develop between members of a project team. This should help to improve relations within the team and contribute to improved performance overall. A system to 'educate' all participants as to the aims and aspirations of a project and its client would also be beneficial in generating a project identity.

**Root Definition:**

*A means by which designers and contractors may improve their cohesiveness and sense of purpose in order that designers interpretations and clients desires for a project can penetrate to individual contractors on site. The system would support the building of a collective identity and impart this to the whole project. The system would aid in the developing of initiatives to develop long term associations among the project team.*

E1=

E2=

E3=

10)

C Grandchildren, contractors, clients

A Contractors, designers, quantity surveyors.

T **Contractors estimating poorly the costs of innovative practice  
→ improved estimating.**

W That an effective cost model for estimating sustainability innovation may be created and that such a model may be generalised for many contractor firms and projects.

O Contractors for construction projects,

E Continued interest in sustainability issues by industry. That contractor firms would employ such a model if it were provided.

When responding to tenders for the construction of a building, sub-contractor costs are estimated based on their previous experience. It is thus the case that innovation, in various forms, presents contractors with situations in which previous experience cannot be used as the basis for estimation. For contractors such innovation thus presents a risk – if the estimate is poor then the risk is higher. In order to offset such risk it is thus necessary to remain cautious by bidding high. However such high bids also risk being undercut. This bidding takes place in an industry context where the value-add of projects is very low, leading to highly cautious approaches as losses are unlikely to be recouped through profits on other projects.

Sustainable construction requires changes to present construction practice and is thus perceived to require innovation and thus unknown risks for sub-contractors. Sub-contractors are thus likely to bid high for such unknowns. This high bidding may suggest overly increased costs of production for sustainable construction practice throughout the industry.

It is thus suggested that a system be devised which may aid contractors in understanding the innovative practices contained within sustainable construction designs to improve estimating the construction cost of such projects.

Such a system should include elements which persuade the sub-contractor in the potential benefits of sustainability innovations to the construction industry, the planet, and for the sub-contractor's future competitive advantage as it can be difficult to increase sustainability through contractual methods alone.

**Root Definition:**

10. *A construction contracting firm owned system which will improve the accuracy of estimation of the costs of innovative practice for the benefit of contractors, clients and future generations. The system will use the skills of contractors, designers and quantity surveyors and development will be a viable project as there will be continued construction industry interest in sustainability and such a system can be generalised across many firms and projects.*

## Vignettes and CATWOEs– First Round

*E1 Accuracy of estimates*

*E2 Cost and time to produce estimates*

*E3 More examples of innovative practice which will lead to more sustainable construction included project tenders.*

11)

C Building clients, designers, grandchildren

A Environmental consultants, designers

T **Inter-relationship of sustainability issues poorly understood → inter-relationships better understood**

W If inter-relationship issues are better understood more sustainable decisions can be reached

O Environmental consultants

E Incommensurability of sustainability objectives, increasing regulatory demands

Sustainability issues remain complex and interrelated. At one level all western approaches to construction are damaging to the environment. Rather than existing as set of segregated and identifiable problems, issues of sustainability remain interconnected. For example, the embodied energy of a building (i.e. the energy used in its construction) is related to the operational energy requirement of the building (to add extra insulation you have to make more insulation!). The complexity of such issues clearly relates to many factors, for example how far materials are moved and by what means, the energy used in their initial construction. Further, at present these issues only refer to the production and use of such materials where in the future the cost of disassembly and recycling may need to be taken into account.

More widely sustainability is measured against numerous metrics, some quantifiable (e.g. energy or water use) others far more qualitative (e.g. effects on communities, users' environment). Promoting one aspect of sustainability may impede reaching other goals.

Appreciating such interrelationships and ensuring that related decisions are optimised requires a rich appreciation of the wide ranging and complex issues.

***Root Definition:***

*11. A system, owned by environmental consultants using their skills and those of designers, which will enable clients and designers to understand better the inter-relationships between different and often incommensurable sustainability issues in order to allow more sustainable decisions to be reached.*

*E1 Sustainability analyses produced and used*

*E2 Cost and time to produce analyses*

*E3 Overall environmental impact of projects reduced*

12)

C Construction client, suppliers, environmental campaigners

A Property procurement staff, suppliers

T **Little knowledge about sustainability impact of activities of suppliers → Comprehensive knowledge about sustainability impact of activities of suppliers**

W Monitoring can be based upon improved knowledge and monitoring can lead to better achievement of sustainability goals and the reduction in risk.

O Client

E Increased external scrutiny of environmental impact of the property procurement supply chain. Little history of attention to these issue in supplier selection and supply chain management.

Sustainability is a contested and complex issue within the construction industry and among the groups attempting to regulate or influence the industry, however the industry is presented with situations in which a concrete definition must be used to make complex decisions. For example client firms wish to ensure that their CSR aspirations are not threatened by environmentally damaging aspects of their property procurement supply chain. Following the Greenpeace highlighting of the use of non-sustainable produced hardwood in the Cabinet Office refurbishment, companies are becoming aware that their property supply chain can present them with reputational risks they have only previously identified in their product supply chain.

A need is thus identified on how to arrive at the identification of sources of threat to clients' reputation throughout the construction supply chain through the use of materials, processes or labour. Supply chain management thus will have to embrace of monitoring of sustainability (environmental, community and economic) risks. The monitoring will lead to improvement in the performance of suppliers and better selection of suppliers.

While the risk from the identification of the use of child labour (c.f. Nike) is lower in the construction industry, the environmental impact of extractive industries (c.f. RTZ) in the materials supply chain is considerable and the use of poorly sourced hardwood is a continuing threat; these activities are not confined to the UK, even for properties constructed in the UK. The overseas operations of contractors also present a reputational risk both to themselves (c.f. Balfour Beatty and Ilisu dam project) and to clients who employ them

***Root Definition:***

12. *A construction client owned database system which will increase knowledge about the sustainability impact of the activities of suppliers which will enable reduction in reputational risk through better selection of suppliers.*

*E1 Increased data on all activities of suppliers, level of use of database.*

## Vignettes and CATWOEs– First Round

*E2 Cost and effort to maintain database*

*E3.Reduced interruption in corporate activities from accusations about suppliers' activities from groups like Greenpeace. Reduced negative publicity.*

13)

C – SMEs

A – SMEs, technology providers

T – SMEs existing in a KM impoverished state → SME's gaining advantage from KM techniques/technologies.

W – Many KM initiatives and technologies tend to be expensive and too unwieldy to implement in SMEs. SMEs do not have the resources to devote to KM but there is little doubt that they could benefit from improved management and exploitation of their knowledge capital.

O – SMEs, technology providers, funding bodies/government.

E – Availability of low cost tools for KM. Emergence of proven techniques for exploiting KM ideas and tools in the workplace; a simple 'how to' guide for the less resource rich to follow.

Whilst the UK's largest construction firms have the resources to develop knowledge management initiatives in-house and sufficient staff to become involved in numerous industry bodies, these firms are relatively few. The vast majority of the UK construction industry is comprised of much smaller entities with fewer if any resources that can be spared for knowledge management type tasks. Furthermore, whilst the larger players often have staff from a number of disciplines to call upon, smaller firms tend to be more narrowly focussed on a specific sector and may find it difficult to solve certain 'cross domain' problems as they don't necessarily have recourse to the relevant expertise in-house.

Initiatives and tools that allow smaller players in the UK construction industry to gain advantage from knowledge management techniques should aid the competitiveness of individual companies whilst simultaneously enhancing the industry wide knowledge base. Such initiatives may also have fringe benefits in improving relationships between firms and possibly fostering strategic alliances allowing consortia of smaller firms to bid for a wider range of projects than would normally be the case. Government and other bodies could encourage such initiatives with funding opportunities.

A possible application of this theory would be tools to support localised 'knowledge networks' between construction firms operating in geographically similar areas.

***Root Definition:***

*13. A system owned by consortia of SMEs (locality or discipline based) to enable SMEs to have access to timely and relevant information about construction practice and process and thus enable their staff to act more knowledgably and for SMEs to, individually and collectively, tender for larger and more profitable*

## **Vignettes and CATWOEs– First Round**

*projects. Such a system requires the availability of low cost tools and techniques that can be applied reliably without constant technical backup or expert advice.*

*E1 Number of SMEs with access to construction knowledge bases.*

*E2 Cost of system vs. value added from its use.*

14)

C – Employees, employers, share holders, clients.

A – Employers, employees

T – Working environments not conducive to acquisition of new knowledge → environments where new knowledge is acquired/assimilated

W – Modern, high-pressure working environments allow little time or space to reflect on and assimilate information or knowledge about new products, techniques and technologies. This leads to a stagnation of the knowledge base within a company and ultimately within an industry

O -Employers

E – The existence of a consistent supply of relevant materials, articles etc. to maintain interest and challenge or indeed reinforce established norms.

The ever increasing drive for efficiency in every aspect of modern business, from hours worked to space utilisation, pay scant regard to any notion of time to reflect on and assimilate new knowledge. Employees spend their entire working day, and often a lot longer, doing their primary tasks for the company. Although many items of potential interest may cross their desks in the course of a normal day (trade/professional journals, product catalogues, white papers etc.), these people rarely have time to devote to digesting any of this material, such is the demand for output imposed by the employer. This can tend to lead to a situation where innovation goes unnoticed and out of date practices are maintained well past their 'sell by date'. Employers could usefully help to create an environment more conducive to reflection by building time into the day and space into the office, where an employee can spend a few minutes talking with colleagues or catching up on industry developments. Further assistance could be provided by filtering incoming information on behalf of employees so that they have a more targeted stream of information upon which to focus. This may be an area where IT can help by using profiling mechanisms to help decide what is relevant to whom.

***Root Definition:***

14. *A construction firm owned system to improve the working environment so that time is allowed for staff to reflect on and assimilate information about new products, techniques and technologies, thus allowing an increased level of innovation.*

*E1 Time allowed for reading and reflection. Number of postings on corporate intranets.*

*E2 Cost per technical note posted by employees on corporate intranets*

*E3 Increased level of successful (re-used) innovation*

## Vignettes and CATWOEs– First Round

15)

C – Construction companies, clients, grandchildren

A – Organisations, partners/suppliers

T – Being seen to be green (for marketing purposes) → Actually being green (environmentally and socially sensitive)

W – Taking a shallow marketing focussed approach to sustainability policies confers no benefit to the environment or community at large. Joining the bandwagon is not enough to claim true ‘green’ or ‘sustainable’ status. In order to achieve this, an organisation must put in place effective policies and procedures that have a genuine impact on the way they do business and which benefit the community and/or the environment.

O – Organisations

E – That environmental and sustainability issues continue to grow in importance. That it continues to make commercial sense to pursue sustainable business practices

Many organisations are becoming aware of the cachet to be gained from being seen to be ‘green’. Such green credentials can take many forms such as being listed on the FTSE4Good index, which requires conformance to certain criteria for corporate social responsibility. These criteria include an environmental sustainability aspect as part of the overall package. However, the cynical might take the view that few, if any, commercial companies really take sustainability seriously and apply themselves to the development of sustainable business practice. Simply publishing an environmental policy and calling oneself ‘green’ is not sufficient. It requires a ‘branch and root’ re-evaluation of business processes, how they impact upon each other and how the whole relates to other businesses and the community at large.

### **Root Definition:**

*A construction firm owned system that will routinise environmentally and socially sensitive practices throughout the firm so that environmental impact of the firm is reduced in practice rather than a projecting an illusion of sustainability over unsustainable practice in order that the long term business gains from sustainability can be realised for the benefit of the firm its clients and future generations.*

*E1 Environmental impact of projects is reduced.*

*E2 Cost of new practices*

*E3 Environmental impact of actions is investigated and minimised as a matter-of-course.*

16)

C – Owner/occupier, community

A – Owner/occupier, designers, contractors, public (attitudes)

T – An expectation of certain ‘norms’ for given building types on the part of owner/occupiers → Changed expectations more in line with a sustainability agenda

W – Owner/occupiers have come to ‘expect’ certain features to exist within buildings of given types. These features are not necessarily sustainable or environmentally friendly and in many cases could be engineered out in favour of better alternatives. The current perceptions or expectations mitigate against this and thus changing those perceptions could have benefits for the environment and possibly the owner/occupier themselves.

O – Owner/occupier

E – That sufficiently compelling arguments exist for changing the design of buildings to more sustainable types. Lack of understanding on the part of the owner/occupiers and the wider community with regard to sustainability.

Those who commission or occupy buildings, be they individuals or commercial concerns, have certain expectations regarding the buildings they are to move into. These expectations cover a wide spectrum of issues from the type of materials used in the construction to the building control systems (or lack thereof) used to monitor the running of the facility. Some of these expectations, for example the expectation that there will be air conditioning in office premises, do not align well with the aims and objectives of sustainable development, which in the example, would seek to ‘design out’ those systems. It would therefore be beneficial to attempt to change perceptions among owner/occupiers such that their expectations take greater note of sustainability issues. This could in parallel with the general raising of awareness of sustainability issues among the public via media attention to such events as the various Earth Summit conferences. It is of course necessary for such re-education to go hand in hand with engineering developments which make sustainable alternatives more attractive to end users. After all, not everyone finds a home with a glass façade built into an embankment and covered with earth an aesthetically satisfactory proposition.

***Root Definition:***

*A construction client owned system, employing the skills of clients, designers and contractors, which will result in the end tenants/users of buildings expecting improved sustainability performance from their buildings rather than trading these benefits for other benefits during project briefing for the benefit of tenants/users and future generations.*

## Vignettes and CATWOEs– First Round

*E1 Reduction in number of sustainable options discarded during value management.*

*E2 Whole life cost of building*

*E3 Increased demand for a stricter regulatory regime, increased range of ways of improving sustainability that can be provided by the industry and are acceptable to a range of clients.*

17)

C – Employers, clients, employees

A – Design teams, contractors, employers

T – Prompts/guides as a tool for minimal compliance → Prompts/guides as a tool/springboard for learning

W – Too often guides and checklists etc. that are meant as an ‘aid-memoir’ become the ‘bible’ on a particular subject, defining compliance lists to work to. This is an undesirable situation as the ‘knowledge’ therein is rarely challenged or refreshed and nobody learns as a result of using them. A better approach is to use such guides as a jumping off point for further research in the area to enhance personal and/or organizational knowledge.

O – Employees/employers

E – Time for further research being available. That a culture exists where best practices, guidelines etc. can be challenged and as a result modified. That those in an organisation have a desire to learn.

Published guidelines, whether internal or industry wide, tend often to be used slavishly as specifications for compliance in a given area. If the guidelines are not kept regularly up to date, the knowledge embedded therein becomes ‘stale’ and the users of the guideline continue to adhere to out of date ideas and principles. The challenge is to encourage users to view such guidelines as a starting point for their own research, if only to validate the guidance given. This way, the knowledge is constantly challenged and any worthy new developments are integrated into the guides in a timely manner. This requires a system of publishing flexible enough to handle regular updates without being too costly in time or money terms, an area where IT can lend a hand.

***Root Definition:***

*A construction firm owned system, engaging all the skills and enthusiasm of their staff that will encourage staff to see checklists as stimuli for learning and knowledge creation rather than as minimal requirements for the benefit of the firms, their staff and their clients.*

*E1 Number of contributions to discussion boards.*

*E2 Staff time engaged in learning activities vs. innovations adopted.*

*E3 Reduction in staff turnover. Securing of higher value projects*

18)

C – Grandchildren, clients, users (occupiers)

A – Design teams, clients, specialist consultants.

T – Poor cost benefit analysis with respect to sustainable construction solutions (poor whole life costing) → improved cost benefit analysis

W – Weak cost benefit analysis of sustainable solutions often results in over inflated capital cost estimates for these solutions. Given the average clients pre-occupation with capital cost in projects, this mitigates against the sustainable alternative being chosen. Better analysis and whole life costing would help to clarify true capital expenditure and medium to long term savings. This could lead to stronger justifications for taking the sustainable option.

O – Specialists consultants (Those have the tools and knowledge to make better cost estimates).

E – A willingness on the part of the client to take seriously the alternatives that are available and to thoroughly conduct their own analysis of the cost benefit in their own context. Availability of the tools and techniques that can lead to more accurate cost estimates. Client's budgetary constraints.

***Root Definition:***

*A specialist consultant owned system, employing the skills of their own staff and those of designers and clients, which will improve the appreciation of the whole life cost savings of sustainable solutions for the benefit of clients, building users and future generation.*

*E1 Utilisation of whole life cost models in project appraisal.*

*E2 Value added from projects*

*E3 Reduction in whole life costs of buildings (including energy and maintenance savings).*

19

C - Client, Grandchildren , Designers.

A - Contractors and designers, project managers

T - Contractors not knowledgeable about designer's intentions and their meaning  
➔ contractors knowledgeable

W - Changes are made by contractors that undermine sustainability gains from design innovations. Designers know what their intentions are, and can share them. Contractors will follow designers intentions if they understand their purpose. Designers intentions are likely to lead to better product if incorporated.

O - Design firms

E - Compliance and quality assurance mechanism/ procedures exist. Effective conversational mechanisms exist between designers and contractors.

**Root Definition:**

*A design firm owned system to ensure designers' intentions are incorporated in buildings as a result of an effective knowledge process for sharing understanding about the intention behind innovations, for the benefit of the client, the designers, and all future generations in order to prevent changes being made that undermine potential sustainability gains. This assumes that designers know what their intentions are and can articulate them; contractors will follow intentions if they understand their purpose. It will employ the skills of contractors, designers and project managers. The system requires that compliance and quality assurance procedures, and effective communication mechanisms between designers and contractors exist.*

*E1 Designs are followed more closely. Quality of work improves.*

*E2 reduction in cost of reworking, time to completion reduced.*

*E3 buildings are more sustainable.*

20

C=Contractors, clients, designers and grandchildren

A=Contractors, designers

T= Designers have insufficient regard to buildability → Designers better understand the problems of contractors

W= Sustainability gains come as much from building quality as they do from design quality; sustainability gains come from designing for buildability as well as designing for sustainability; and that designers can be persuaded to prioritise practicality above elegance.

O=Contractors

E= Sufficient funds to pay for time required to communicate buildability

**Root Definition:**

*A contractor owned system, using the skills of designers and contractors and sufficiently funded to allow adequate time for communication, which will ensure that designers understand the problems contractors face in realising their designs to an acceptable quality, as realising sustainability potential requires designs that pay sufficient attention to buildability even if it means sacrificing elegance, for the benefit of contractors, clients, designers and future generations*

*E1 Contractor requests for information of designers decrease*

*E2 Communication costs*

*E3 Contractors receive drawings that encompass sustainability and can be easily built.*

C=Client, Grandchildren, Contractors.

A=Contractors, Designers, Informational facilitator

T= Information that explains the design rationale not available to the contractors  
➔ information available.

W= Changes are made that undermine sustainability gains from design innovations. More information will lead to greater understanding. The design rationale can be sufficiently expressed. Designers believe that design rationale needs explaining.

O=Design firms

E= Time, cost, quality, - Communication technologies are available between designer and contractor. Contractors are interested in design rationale. Contractors will budget time to appreciate design. Sufficient management exists to ensure that the process can operate and that conflicts can be resolved.

**Root Definition:**

*A design firm owned system, using the skills of designers contractors and informational facilitators that will make information on design rationale available to contractors so that contractors will not make changes that undermine sustainability if they have sufficient information to understand the design rationale subject to designers commitment to explaining their rationale and that this can be achieved sufficiently to lead to greater understanding. The system is dependent upon communication technologies linking designers and contractors being available and used and there are managerial resources available to operate the system and resolve conflicts.*

*E1 Design rationale documentation produced and supplied to contractors.*

*E2 Cost of running system vs. cost of rework*

*E3 Envisaged sustainability gains are realised*

22

C = Contractors, designers, consultants, clients

A = Construction professionals and managers

T = Knowledge lost between projects → Knowledge retained

W = “A commonality exists between projects”. This can be captured. This makes the learning from previous projects a useful activity.

O = Construction firm

E = Time and money allocated to debriefing and feedback activities and systems available for storing and communicating information about lessons learned.

***Root Definition:***

*A construction firm owned system that using the skills of project teams enables knowledge gained in projects to be retained and applied to other projects which have common elements through debriefing and feedback activities and the investment in systems to store and disseminate records of lessons learned.*

*E1 Number of items in lessons learned database*

*E2 Cost of debriefing activities and information system maintenance*

*E3 Outcomes from application of lessons learned to future projects*

23

C = Design firms, contractors

A = Managers

T= Innovation is seen as a Risk → Innovation seen as business opportunity.

W= Our margins are so low we have to avoid all risk. No one will compensate us for taking risks. IPR is very weak in the industry – easy to copy. It's very easy to reverse engineer a building – you can see how it is built.

O = Construction firm

E = Stock market demands

***Root Definition:***

A system to enable management teams produce cultural change in a construction firm so that innovation is viewed positively as a business opportunity rather than negatively as a risk despite the weak IPR regime and low margins and the pressures from the stock market.

*E1 Inauguration of incentive schemes to reward innovative employees*

*E2*

*E3 Increased margin on projects to reflect gains from innovatory practice*