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A Sustainable Approach to the Project Management Odyssey

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Abstract

The major contribution of the project management supports the large increase in its recognition as a profession; generally to all fields but specifically to the construction industry. By adopting key sustainability principles, construction can be transformed from problem to solution from each of an *economic, social* and *environmental* perspective; *three parallel levels* often known as the *Triple Bottom Line*. The contribution that construction can make to the delivery of a sustainable development agenda is now clearly understood. The argument that sustainable practices can make a major contribution to the long-term viability of the construction industry is compelling, but much less widely appreciated. This paper, based on work being carried out by Eid in support of a doctoral thesis, sets out to make the business case for sustainable construction and argues that barriers to realising the business case can be overcome by changing the business models employed by construction clients and construction companies. Also identifies the existing potentials within the project management practice to embed sustainable development and allow the construction industry to benefit on all three parallel levels. Specific focus is placed on new approaches to the integration of *project management processes* and *sustainability* as well as the possibilities in adopting *Systems Thinking* in allowing this integration on all management levels.

Introduction

There is now overwhelming evidence that human development is depleting natural capital at a faster rate than it can be replenished and is producing waste products at rates greater than global eco-systems can absorb (UNEP GEO, 2000). The consequence of operating economic systems beyond ecological limits is the destruction of the resource base and the whole-scale pollution of the life support systems upon which continued human development depends (RCEP, 2000).

The Intergovernmental Panel on Climate Change (IPCC, 2001) is calling for urgent measures to prepare for sea level rises, serious drought, floods and storms which threaten disaster for large areas of world.

Construction stands identified as a major part of the problem, as a primary contributor to climate change, resource depletion and pollution (DTI, 2000). Buildings consume energy in their operation and in the extraction and preparation of materials. The consequence is that the construction industry is directly and indirectly responsible for 50% of the total UK energy consumption and, given the present fuel mix, half of the resultant CO₂ emissions as a result of the construction and use of buildings and from the extraction and processing of materials. In the past one hundred years the level of CO₂ in the atmosphere has risen 27%, one quarter of which has come from burning fossil fuels just to provide energy for buildings. Carbon dioxide emissions from housing, account for over a quarter of UK emissions.

By any standards, the construction process as presently managed in the UK is highly inefficient, as confirmed by the recently published report of the Construction Task Force "*Rethinking Construction*" (DTI, 1998). It also places emphasis on the need for a radical change of culture within the industry.

Construction is therefore clearly identified as part of the problem. It needs to be made part of the solution.

The construction industry has a major contribution to make to quality of life and to national economies. At a European level, the industry has achieved a level of competitiveness on a par with that of its main competitors (EU Commission, undated). Construction, building materials, and associated professional activities - including Project Management - account for a significant percentage of the Gross Domestic Product. Such success has been achieved however at the expense of creating major environmental and social problems. The challenge is to make construction environmentally and socially sustainable without compromising its economic viability.

New policy initiatives and legislation can play a vital part in bringing about necessary transformations but change is unlikely to happen unless the industry as a whole is convinced that there is a business case for more sustainable construction.

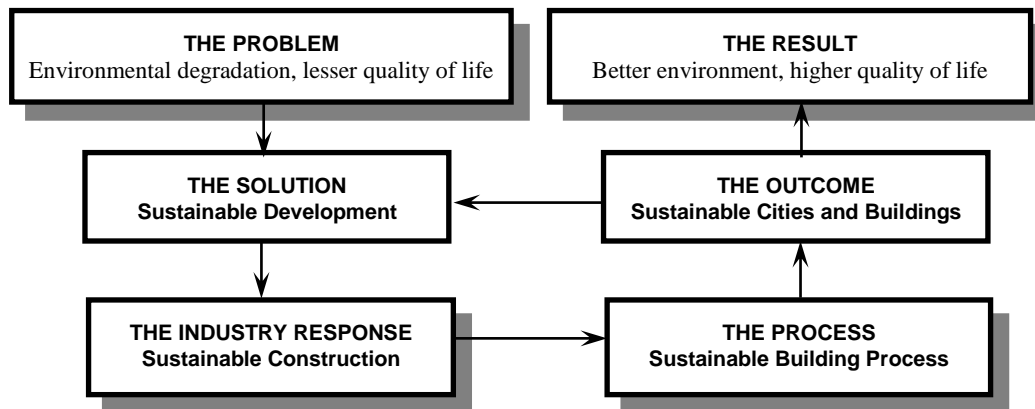


Exhibit 1: A Sustainable Construction Road Map (CIB, 1998)

Identifying the problem is the obvious part of the task, but we need to rethink construction so that all of the parties involved have to play a part. We need to find a way to co-operate that can add value to all. (Blockley, D. and Godfrey P., 2000). This means that we are not after the single method as the way to achieve better practices, but it is a new thinking, with a strong philosophy that gives a coherent set of concepts that integrate and add value to the best of the existing ideas. The use of Systems thinking is the gateway to change and the way this paper will demonstrate the potential of this theory in leading the industry through Project Management to a more sustainable future.

In order to drive the existing system into a more sustainable approach, Leverage Points will be the passage through such a complex system as project management for the construction practices. It is not only about systems analysis but further than that, it is about the places to intervene in a system where a small shift in one thing can produce big changes in everything. (Meadows, D. 1999)

In this paper, sustainable construction practice is the goal, that if reached, it has to be through explaining the business case for it. As the project management represents a significant element within the process, the author addresses the integration between three vital elements: PMBOK, Sustainability and Competitiveness. The integration is seen as the way forward underpinned by the rethinking of the system as well as the areas of knowledge through new systems thinking.

The objective of this paper is to demonstrate the vital role of project management processes within the construction projects and industry to reveal the potential of better performance when sustainable development is embedded onto the processes through systems thinking. Identifying the places to intervene in the existing processes help to exhibit the sustainability gaps in the system and therefore ensures a better and stronger impact for a more sustainable performance.

It is simply the quality of our lives that we wish to improve and all sectors whether private or public have a role to play; and it is our role as researchers in the field of project management to highlight the need for the change and the way in pursuing our objectives to guarantee a better quality of life for us and for generations to come.

Sustainable Construction

Under the generic title of sustainable development three key policy agendas – climate change, social inclusion and competitiveness – are currently converging to present a radical challenge to the construction industry. That challenge is for construction companies to work collectively to integrate vital environmental and social considerations into their financial planning and business management. Greater resource efficiency lies at the heart of the sustainable development challenge for the construction industry (CIB, 1999). Delivering social progress, protection of the environment, better resource use, economic growth and employment require a stable and competitive economy.

Since the publication of the report of the World Commission on Environment and Development (The Brundtland Report) in 1987, there have been innumerable debates as to what is meant by sustainable development. The most common definition, which was included in the Brundtland Report, describes sustainable development as: “*the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*”. (The Brundtland Report, 1987)

William James -the American philosopher- describes the journey of sustainable development like all significant ideas in the world history; Sustainable Development has passed through three stages: first being rejected, then being admitted as true but insignificant and finally being seen as so important that its opponents claim to have thought of it first.

The key message is that sustainable development is not incompatible with competitiveness. Business cases have many opportunities to create environmental and/or social improvements whilst increasing profits and market shares which can create new sources of employment.

Sustainable development embraces the three broad themes of environmental, social and economic accountability, often known as the “Triple Bottom Line” (Elkington, 1999). It is about ensuring a better quality of life for everyone, now and for generations to follow.

“Sustainable development isn’t outstanding environmental performance at the cost of a company, which goes out of business, nor is it outstanding financial performance at the cost of adverse effects on the local environment and communities. It does not demand the perfect solution. Sustainable development is essentially a goal or vision that forward looking organisations are working towards.” (CBPP, 2001)

This goal of sustainability is the process of systematically and effectively integrating vital environmental and social concerns into economic development, financial planning and project management.

Business has reconciled the need for sustainable development with the demands of competitiveness through the concept of eco-efficiency.

“It is clear that the various activities of the construction sector have to be regarded and analysed when considering sustainable development. As a matter of fact, on one side, the built environment constitutes one of the main supports (infrastructures, buildings) of economic development, and, on the other side, its construction has significant impacts on resources (land, materials, energy, water, human/social capital) and on the living and working environment. Hence the construction industry has a lot of direct and indirect links with the various aspects of sustainable development.” (CIB, 1998)

Sustainable construction as a process promotes affordable solutions to the problems of the build environment that are ecologically intelligent, use benign energy, respond to local conditions and eliminate the concept of waste. So much is clear. The critical question is, can the business case be made equally compelling?

The Business Case for Sustainable Construction

The author believes that following sustainability principles (CIRIA, 2001 Pending Publication) can produce demonstrable business benefits by reducing costs, improving quality and increasing marketability. This aligns the policy objectives of sustainable construction with those of the Egan Agenda and the UK's Strategy for Sustainable Construction published by the Department of Trade & Industry (DTI, 2000).

What is implied here is not a trade-off but an approach to construction that sets out to satisfy the business case for sustainability by meeting essential economic, social and environmental objectives (WBCSD, 1997).

Contemporary studies (CIRIA, 2001 pending publication) suggest that a strong business case can exist for clients to adopt sustainable construction. These can be summarized as:

- An increase in building performance and customer satisfaction
- Increased shareholder value - as perceived risks of stock ownership are reduced
- Reduced costs
- Reduced risk
- Enhanced public relations and community liaison
- Increased employee motivation and enhanced productivity
- A better product through design teams being able to explore a wider range of solutions
- More efficient design and construction
- Reduced costs through new forms of accounting involving whole life costing
- Holistic, sustainable and appropriate environmental solutions
- Better decision-making through an informed balance of quality and cost
- Reduced liability through better risk management
- Minimisation of the financial penalties and negative publicity associated with non-compliance with environmental regulation
- Improvements in business efficiency through active management of sustainability performance
- Increased capacity to innovate and improve efficiency and reduce waste
- Ability to recruit most able staff
- Capacity to retain able staff, reducing recruitment, training costs and loss of institutional knowledge
- Stronger long term relationships and ways of working with business partners through greater use of partnering arrangements.
- High opportunity costs in terms of loss of customer confidence and competitiveness stemming from poor sustainability performance
- Other business benefits can arise from effective working with local communities (Thomson and Talbot, 1998)

However strong the case, it is not yet seen as compelling enough to provoke an industry wide take-up of sustainable practices needed to make construction part of the solution (CIRIA, 2001 pending publication).

Sustainability Vs PMBOK

The project management (PM) practices in the construction industry are fundamental to the successful completion of any construction project. The author believes that sustainability has a significant contribution to the PM process and in order to lead the construction industry through a more sustainable path, the collaboration of all practices involved with the industry including PM is essential.

The progress of the construction industry mainly relies on the ongoing relationship between stakeholders, economic value and the built environment, and PM is no different:

“Projects and project management operate in an environment broader than that of the project itself” (PMBOK, 2000)

The Project Management Book of Knowledge (PMBOK, 2000) refers to sustainability briefly without making explicit the essential points of connection between sustainability and project management. Nevertheless, some key points have been mentioned: -

“The project management team must understand this broader context-managing the day-to-day activities of the project is necessary for success but not sufficient.” (PMBOK, 2000)

The key aspects of the project management context described in the PMBOK are:

- Project phases and the project life cycle
- Project stakeholders
- Organizational Influences
- Key general management skills
- Social-Economic-Environmental Influences

Obviously the fifth key aspect is all about the triple bottom line. In the author's view, the barriers to be overcome would be more manageable by linking and integrating the three elements of this paper; PM, Sustainability and competitiveness. This integration would deliver a clearer business case for sustainable construction.

Competitiveness Vs Sustainability

Seeking a more profitable and competitive economy for the construction industry, the European Commission has identified some key elements to improve the industry's competitiveness to achieve four major objectives. These objectives are improving the quality in construction, improving the regulatory environment, improving the education and training provision and finally re-orienting research and development.

A simple table can be used to emphasise the linkages between sustainability and the key interrelated elements of competitiveness.

Key Interrelated Elements of Competitiveness	The Sustainability Linkage
Quality	Clients now expect companies to compete on quality as well as price. Sustainability is clearly established as a key component of quality.
Markets	Leading sustainable companies will be in a strong position not simply to meet the needs of markets but to transform them (Elkington, 1999)
Equitable market conditions	Companies not promoting sustainable practices will be exposed. Those investing in best sustainability practice and able to add real value to contracts will be rewarded
Construction process	The future for the construction industry will be a future of change, and will be knowledge-driven. Only companies willing and able to work through new forms of procurement and collaborative working will prosper. Collaboration and integrated working is of the essence in sustainability.
Environment	Customers are growing wise and discriminating in demanding environmentally sound products and services. Such outcomes are fundamental to sustainable construction
Regulatory framework	The regulatory environment is responding to the growing threats of climate change and resource depletion and will eventually regulate non sustainable companies out of existence
Human resources	Respect for customers and for employees is of the essence in sustainable enterprise. Willingness to invest in training and job satisfaction will be key indicators of the competitive company of the future
Technology	Forward planning, future proofing and investment in innovative technologies and systems of management are key aspects of sustainability - and competitiveness
Structure of the sector	Sustainable economic systems will be diverse systems held together by effective networks. Fragmentation and disconnection are characteristics of un-competitive structures
Illegal practices	Regard for sustainability best practice will drive out the shoddy and the corrupt

Exhibit 2: Linking Sustainability to the Key elements of competitiveness.
 (Eid, M. and Talbot, R. PMI Europe 2001 conference paper)

PM Vs Competitiveness

Having discussed the contribution of sustainability to competitiveness as a major contributor to the business case; we seek to demonstrate the contribution of sustainability to project management processes and areas of knowledge (as identified by PMBOK).

The linkage of sustainability to project management is described in the following elements:

1. Standards and Regulations
2. Internationalization
3. Cultural Influences
4. Social-Economic-Environmental Sustainability

The European Commission in defining some of the key interrelated elements of competitiveness also uses these four elements, as follows:

• **Markets:** Where the Commission argues the competitiveness level on different levels of Markets mainly on the International level where circumstances that might affect the project are different than what the EU organizations might be used to due to the vast contribution of the European construction industry to the international market.

• **Equitable Markets:** *“Internationally, given the strong position of the EU companies in the global market and the size of the contracts at stake, the EU has a proactive interest in ensuring that markets are open on equal terms.”* (EU Commission, undated)

• **Construction Process:** The need to adapt to developments in technology and practice is driving the change in the construction process. *“Key aspects in improving the overall efficiency and competitiveness of the sector are the development and new relationships between actors, enhancements in communication and decision making, and the improved organization and management of the whole process, particularly on site”.* (EU Commission, undated)

• **Environment:** The European Commission describes the achievement of environmental objectives and the early integration of environmental concerns in the construction life cycle are drivers for improving the industry’s environmental record as advised in the PMBOK. Both refer to such concerns as tools for improving social aspects of the process as well as environmental.

• **Human Resources:** as a key element of competitiveness, it has a major impact on the social side of any project. Both project management context as well as the theory of competitiveness call for better human resources awareness and training as a tool for delivering a better social as well as economic aspect for the business case.

• **Technology:** Innovation and technology combine to deliver a better competitive industry. Regulations and Standards described by the PMBOK as an element of the PM context have their own fundamental input on the technology used for the project. The difference between regulations and standards has to be clear to avoid the influence of this confusion on the technology used to minimize the project risk of technology misuse.

Project Management Vs Sustainability

The author perceives the PM process as a fertile environment for developing a more sustainable process; believing that the key lies with the points of contact between the project management processes and the triple bottom line (Elkington, 1999) of sustainability through the Areas of Knowledge identified by the PMBOK.

Triple Bottom PM Processes	SOCIAL		ECONOMIC		ENVIRONMENTAL	
	PM Area of Knowledge	Relevance	PM Area of Knowledge	Relevance	PM Area of Knowledge	Relevance
1- INITIATING	5.1 Initiation	***	5.1 Initiation	***		
2- PLANNING	4.1 Project Plan Development	***	4.1 Project Plan Development	***	4.1 Project Plan Development	***
	5.2 Scope Planning	***	5.2 Scope Planning	***	5.2 Scope Planning	***
	5.3 Scope Definition	***	5.3 Scope Definition	***	5.3 Scope Definition	***
	6.1 Activity Definition	***	6.1 Activity Definition	***	6.1 Activity Definition	***
	6.2 Activity Sequencing	**	6.2 Activity Sequencing	***	6.2 Activity Sequencing	**
	6.3 Activity Duration Estimating	*	6.3 Activity Duration Estimating	**	6.3 Activity Duration Estimating	*
	6.4 Schedule Development	*	6.4 Schedule Development	**	6.4 Schedule Development	*
	7.1 Resource Planning	**	7.1 Resource Planning	***		
				7.2 Cost Estimating	***	
				7.3 Cost Budgeting	***	
	8.1 Quality Planning	**	8.1 Quality Planning	**	8.1 Quality Planning	**
	9.1 Organisational Planning	***	9.1 Organisational Planning	*		
	9.2 Staff Acquisition	***				
	10.1 Communication Planning	**	10.1 Communication Planning	*		
	11.1 Risk Management Planning	**	11.1 Risk Management Planning	***		
11.2 Risk Identification	***	11.2 Risk Identification	***	11.2 Risk Identification	***	
11.3 Qualitative Risk Analysis	**	11.3 Qualitative Risk Analysis	***	11.3 Qualitative Risk Analysis	**	
11.4 Quantitative Risk Analysis	**	11.4 Quantitative Risk Analysis	***	11.4 Quantitative Risk Analysis	**	
11.5 Risk Response Planning	**	11.5 Risk Response Planning	***	11.5 Risk Response Planning	**	
3- EXECUTING			12.1 Procurement Planning	***	12.1 Procurement Planning	**
	4.2 Project Plan Execution	*	4.2 Project Plan Execution	***	4.2 Project Plan Execution	*
	8.2 Quality Assurance	*	8.2 Quality Assurance	**	8.2 Quality Assurance	*
	9.3 Team Development	***				
			10.2 Information Distribution	**		
4- CONTROLLING			12.4 Source Selection	***	12.4 Source Selection	**
	4.3 Integrated Change Control	*	4.3 Integrated Change Control	*	4.3 Integrated Change Control	*
	5.4 Scope Verification	***	5.4 Scope Verification	***	5.4 Scope Verification	***
	5.5 Scope Change Control	***	5.5 Scope Change Control	***	5.5 Scope Change Control	***
	6.5 Schedule Control	**	6.5 Schedule Control	**	6.5 Schedule Control	**
			7.4 Cost Control	***		
			8.3 Quality Control	**		
		10.3 Performance Reporting	**	10.3 Performance Reporting	*	
5- CLOSING	11.6 Risk Monitoring & Control	**	11.6 Risk Monitoring & Control	**	11.6 Risk Monitoring & Control	**
	The Closing Prozesse is not directly related to the Sustainability approach because it mainly consists of paper work and documentations of the legal aspects as well as the analysis of the targets achievement and the lessons learned.					

Exhibit 3: Mapping of Project Management Processes to Sustainability through Knowledge Areas.

The PM Area of Knowledge Key:

4- Project Integration Management

6- Project Time Management

8- Project Quality Management

10- Project Communications Management

12- Project Procurement Management

5- Project Scope Management

7- Project Cost Management

9- Project Human Resource Management

11- Project Risk Management

This Table is not meant to be exclusive, but to demonstrate how the PM Processes can be integrated with Sustainability and to identify the potential areas of knowledge, which could lead to a more sustainable approach.

Integrating the Elements in Question

The integration key lies within the common points between the Project Management Processes and the Triple Bottom Line of sustainability through the Areas of Knowledge identified by the PMBOK. The need for more sustainable development approaches into the construction industry should now be obvious, but the challenge exists within the integration of the three elements in question; Project Management, Sustainable Development and the Construction Industry.

Acknowledging the previous Exhibit 3, the project management process proves to be a fertile environment for developing a more sustainable process. Embedding sustainability within the tools and techniques of each area of knowledge would inevitably deliver more sustainable outputs.

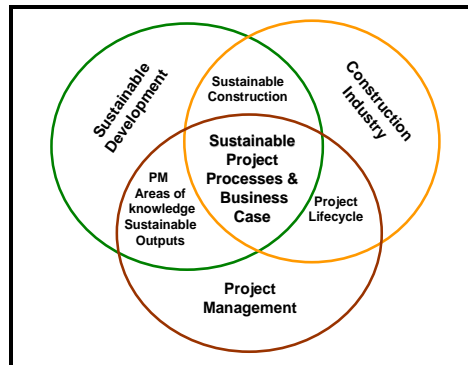


Exhibit 4: Integrating the Three Elements in Question.

(Eid, M. and Talbot, R. PMI Europe 2001, contributing conference paper)

Systems Thinking

We should be sufficiently convinced of the need for change by the impelling proofs described earlier; even clients' willingness to pay and investment in a more sustainable project is now underpinned by the description of the potentials of the business case for sustainable development.

There is an opportunity to rethink construction, since change is inevitable and the pressures for further changes are obvious. This is directly related to the future of our industry and in fact to our quality of life. In order to change, we need to reach out for thinking differently and making a difference, which will take some effort and one consistent framework that focuses on the system's process.

Systems thinking offer a significant opportunity for change. Systems thinking help us to: -

- Integrate the current initiatives.
- See what is common.
- Reassess the scope of quality and value.
- Recognise the need for radical change.
- Deliver customers focused strategies.
- Realise values from processes driven by impelling propositions.
- Integrate people and processes.
- Generate simplicity out of complexity.
- Demonstrate practical rigour.
- Create tools to manage uncertainty.
- Think in loops and not in straight lines.

(Blockley, D. and Godfrey P., 2000)

Admitting that construction and project management are considered as complexes systems, the key is to concentrate and focus on the process, which is the core concept on which all other ideas are hung as attributes to represent what the process is. Focusing on the process bearing in mind a clear definition of the need would help us identify the leverage points for the system.

The behaviour of all systems follows certain common principles, the nature of which are being discovered and articulated. “At its broadest level, systems thinking encompasses a large and fairly amorphous body of methods, tools, and principles, all oriented to looking at the interrelatedness of forces, and seeing them as part of a common process.” (Senge, P., 1999)

As we have a common vision of the need we need to achieve towards a more sustainable performance, we recognise that we need a certain strategy for pursuing this vision. This is where the need for finding *Leverage Points* seems indispensable. Even if these leverage points would represent small changes, we only have to recognise that we are pushing them in the right direction.

“Small Changes can produce big results- but the areas of high leverage are often the least obvious” (Senge, P., 1990)

Leverage Points; Places to Intervene in a System

“Leverage Points are places within a complex system where a small shift in one thing can produce big changes in everything”. (Meadows, D., 1999)

Leverage points are points of power, J.W. Forrester thinks “People know intuitively/instinctively where leverage points are” but the problem is that “everyone is trying very hard to push them in the wrong direction”. Complex systems are “counterintuitive” as described by Forrester. Since Leverage points are intuitive we tend to use them backward, systematically worsening whatever problems we are trying to solve.

Donella Meadows describes her list of leverage points as “an invitation to think more broadly about the many ways there might be to get systems to change, therefore it is not a simple, sure-fire recipe for finding leverage points”. To introduce this list and a short analysis of its elements, a simple diagram provides a basic perspective of any system.

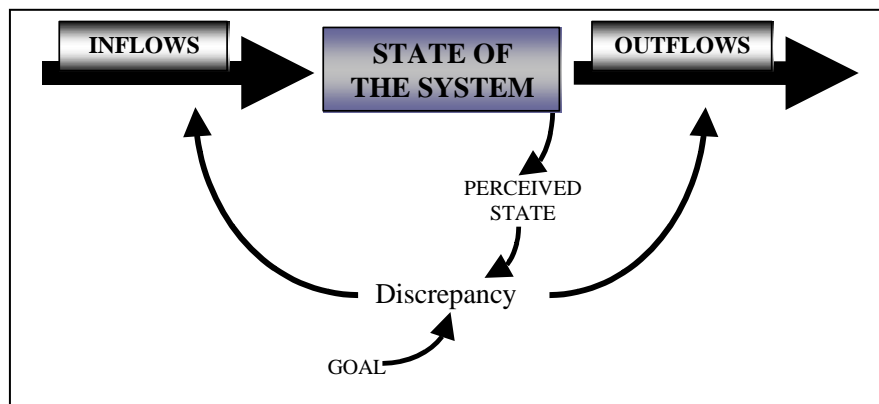


Exhibit 5: The State of the System Diagram.

(Meadows, D., 1999 Leverage Points: Places to Intervene in a System)

In this diagram, the “state of the system” is whatever standing stock is of importance, which is usually physical stocks, but they could be nonmaterial ones as well. There are usually inflows that increase the stock and outflows that decrease it. The rest of the diagram shows the information that causes the stock to change.

The Leverage points described in this report, would fortify the next stage of this paper where we would try to adopt this theory on a generic procurement process and identify the leverage points where sustainability can be embedded onto the existing system, in trial to lead the system into the right direction of better sustainable performance.

The Places to intervene in a system (Leverage Points) are: *in an increasing order of effectiveness*

12. Constants, Parameters, and Numbers: -

Parameters in systems jargon are the numbers that determine how much of a discrepancy turns which faucet how fast. Parameters are the points of least leverage on the list of interventions although 99 percent of the attention goes to parameters but there's not a lot of leverage in them.

Not that they aren't important. They can be, especially in the short term and to the individual who's standing directly in the flow. People care deeply about parameters and fight fierce battles over them, but they rarely change behaviour.

11. The sizes of buffers and other stabilising stocks, relative to their flows:

Stocks that are big, relative to their flows, are more stable than small ones. A big, stabilising stock is known as a buffer.

The stabilising power of buffers is why we keep money in the bank rather than living from the flow of change through our pocket. It's why stores hold inventory instead of calling for new stock just as customers carry the old stock out the door.

We can stabilise a system often by increasing the capacity of a buffer, but if a buffer is too big; the system becomes inflexible. It reacts too slowly and big buffers of some sorts cost a lot to build or maintain.

The reason why buffers are at the less influential end of the list of leverage points is because they are usually physical entities, not easy to change.

10. The structure of material stocks and flows and nodes of intersection:

The only way to fix a system that is laid out wrong is to rebuild it, if we can. *Physical structure is crucial in a system but rarely a leverage point, because changing it is rarely simple.* The leverage point is in proper design in the first place, after the structure is built, the leverage point is in understanding its limitations and bottlenecks and refraining from fluctuations or expansions that strain its capacity.

9. The lengths of delays, relative to the rate of system changes:

Delays in feedback loops are common causes of oscillations. If you're trying to adjust a system state to your goal, but you only receive delayed information about what the system state is, you will overshoot and undershoot.

A system cannot respond to short-term changes when it has long-term delays. *A delay in a feedback process is critical relative to rates of changes in the system state that the feedback loop is trying to control.*

Overlong delays in a system with a threshold -a danger point- range past which irreversible damage can occur, cause overshoot and collapse.

8. The strength of negative feedback loops, relative to the impacts they are trying to correct against:

Moving from the physical part of the system to the information and control parts, where more leverage can be found. Negative feedback loops are found everywhere (ubiquitous) in systems. Nature evolves them and humans invent them as controls to keep important system states within safe bounds.

Any negative feedback loop needs a goal, a monitoring and signalling device to detect excursions from the goal and a response mechanism. A complex system usually has numerous negative feedback loops that it can bring into play, so it can self-correct under different conditions and impacts. They may not be visible but their presence is critical to the long-term welfare of the system.

7. The gain around driving positive feedback loops:

A negative feedback loop is self-correcting;

A positive feedback loop is self-reinforcing.

The more it works, the more it gains power to work some more.

Positive feedback loops are sources of growth, explosion, erosion and collapse in systems. Reducing the gain around a positive loop is usually a more powerful leverage point in systems than strengthening negative loops, and much preferable to letting the positive loop run.

6. The structure of information flows:

It's not a parameter adjustment, not a strengthening or weakening of an existing loop. It's a new loop, delivering information to a place where it wasn't going before and therefore causing people to behave differently. Missing feedback is one of the most common causes of system malfunction. Adding or restoring information can be a powerful intervention, usually much easier and cheaper than rebuilding physical infrastructure. It is important that the missing feedback be restored to the right place and in compelling form.

5. The rules of the system:

The rules of the system define its scope, its boundaries, and its degrees of freedom. As we try to imagine restructured rules like these and what our behaviour would be under them, we come to understand the power of rules. They are high leverage points. *Power over the rules is real power.*

4. The power to add, change, evolve, or self-organise system structure:

The most stunning thing living systems and social systems can do is to change themselves utterly by creating whole new structures and behaviours.

(Self-organisation)

It means changing any aspect of a system lower on this list: adding completely new physical structures, such as brains or wings or computers; adding new negative or positive loops: making new rules.

The ability to self-organise is the strongest form of system resilience.

Self-organisation is basically the combination of an evolutionary raw material—a highly variable stock of information from which to select possible patterns— and a means of experimentation, for selecting and testing new patterns.

Any system, biological, economic, or social that becomes so encrusted that it cannot self-evolve, a system that systematically scorns experimentation and wipes out the raw material of innovation, is doomed over the long term on this highly variable planet.

3. The goals of the system:

The goal of a system is a leverage point superior to the self-organising ability of a system. If the goal is to bring more and more of the world under the control of one particular central planning system, then everything further down the list, physical stocks and flows, feedback loops, information flows, even self-organising behaviour, will be twisted to conform to that goal.

Survival, resilience, differentiation, evolution are system-level goals.

Corporate power and goals are a high leverage point applicable to all kinds of systems, even cancer cells and government policies; it's the goal of every living population.

2. The mindset or paradigm out of which the system arises:

The shared idea in the minds of society, the great big unstated assumptions—unstated because unnecessary to state; everyone already knows them— constitute that society's paradigm, or deepest set of beliefs about how the world works.

Paradigms are the sources of systems. From them, from shared social agreements about the nature of reality, come system goals and information flows, feedbacks, stocks, flows and everything else about systems.

You could say paradigms are harder to change than anything else about a system, and therefore this item should be lowest on the list, not second-to-highest. But there's nothing necessarily physical or expensive or even slow in the process of paradigm change.

Changing paradigms could be by modelling a system on a computer, which takes you outside the system and forces you outside the system and forces you to see it whole.

1. The power to transcend paradigms:

There is yet one leverage point that is even higher than changing a paradigm. That is to keep oneself unattached in the arena of paradigms, to stay flexible, to realise that no paradigm is true, that every one, including the one that sweetly shapes your own worldview, is a tremendously limited understanding of an immense and amazing universe that is far beyond human comprehension. It is to let go into "Not Knowing".

If no paradigm is right, you can choose whatever one will help to achieve your purpose.

In order to move on to the next and final stage of this paper, the lessons that have to be retained from this analysis of the list of Leverage Points have to be highlighted. The higher the leverage point in question is on this list, the higher and more effective impact it has on the system. It is not by enforcing the change onto the system, but identifying the potential/gaps within the existing framework that we could achieve a higher level of positive impact towards the targeted objective.

The recent initiative of the Office of Government Commerce (OGC) in the UK proves itself as a practical example to be analysed in order to identify where the leverage points exist and identify the sustainability gaps within the existing system.

The Office of Government Commerce (OGC) Best Practise

The Generic Procurement Project Process (The Gateway Process)

From January 2001 the Gateway Process will be mandatory for all new high-risk projects that involve procurement in the Civil Departments of Central Government in the UK together with their Executive Agencies. The process will also apply to information technology procurement projects of all sizes. The Gateway Process is based on well proven techniques used in the private sector that least to more effective delivery of benefits together with more predictable costs and outcomes.

The Gateway Process considers the project at critical points in its development. These critical points are identified as gates. There are five gates during the life cycle of a project, three before contract and the other two looking at service implementation and confirmation of the operational benefits.

A Sustainable Approach

The Gateway Reviews aims at a high level of control and minimisation of risk for all procurement projects to achieve an all round social, environmental and of course economic benefits for all sectors and parties involved.

Although discussing in each of the five Gateways Reviews matters like business case, review teams, reports, lessons learned, procurement strategies, supply methods, development of service, evaluation of benefits and general management benefits; the Reviews do not include sustainable development as a major objective in their plans.

Sustainable Development seems vital to the completion of such process, especially when providing a procurement process for construction projects in order to achieve a better level of social service, protect the environment and of course completing a successful business case.

The Egan Report discussing needed changes to the construction industry had a similar lack of addressing the issue of Sustainability directly, and although these changes have been discussed in several reports following the publication of the Egan Report, still Sustainable Development has to be addressed as a major approach.

This is exactly what the OGC Gateway Reviews need to complete; the generic procurement project process towards a more sustainable future for the construction industry.

“Leverage Points” Vs. OGC Gateway Reviews

The model proposed by the OGC including the five Gateway Reviews, is a complete generic system for procurement project process and when considering modifying or enhancing this system,” Leverage points: Places to intervene in a system” seems to address the right ways for enhancement.

Identifying the Leverage points within the OGC Generic Procurement Process

As described earlier, the existing model lacks the influence and benefits of sustainable development as a main part of its constituents. Therefore, when studying the possibility of integrating sustainability into the existing model, the need to base this integration on efficient places to intervene in the system seemed vital.

The need to deal with this model in separate stages following the Gateway Reviews as well as a whole system was the main concern. Five Gateway Reviews representing five stages in the project life cycle but still working within the same system. Among the list of twelve Leverage Points discussed earlier, several points will be used to integrate sustainability onto the existing system but definitely not all of them.

In general, clear Leverage Points for the whole system would be through “the goals of the system” (Leverage Point 3) as well as “the mindset or paradigm out of which the system arises” (Leverage Point 2). Integrating sustainability through these two leverage points, with high increased order of effectiveness aims at assuring that sustainability is firmly fitted into the purposes and deliverables of the model.

That’s following the belief that sustainable development has to be on the top of the goals achieved by the system so that every other deliverable would follow the strategic level of integration.

The mindset from which the system arises is based on delivering a high level of service while minimizing the risk of procurement for a better social, environmental and economic performance and this basically and clearly where Sustainable development fits in the main framework of the system.

EXHIBIT 6: Generic Procurement Project Process (Sustainable Approach)

Boxes shaded in grey = the original OGC procurement process.

Boxes shaded in green= the proposed sustainable approach highlighting the leverage points.

Gateway Review 1: *Business Justification*

The review focuses on the project's business justification, providing assurance to the project board that the proposed approach to meeting the business requirement has been adequately researched and can be delivered.

Justifying the business case is fundamental to the scope of the model and the continuity of the whole project; therefore integrating sustainability into this Gateway Review through "the rules of the system" Leverage Point 5 seems to accomplish the target. Through this high efficient point, sustainability can be part of defining the scope, boundaries and constraints for this stage.

A sustainable approach to the business case especially on the strategic level of making primary decisions is proved evidence that no conflict exist between the economic benefits and the goal of achieving sustainable development.

Gateway Review 2: *Procurement Method and Sources of Supply*

It assesses the project's viability and potential for success and whether it is ready to invite proposals or tenders from the market. This review reassures the project board that the selected procurement approach is appropriate for the proposed acquisition.

Considering a sustainable procurement method and a sustainable approach to the whole Gateway would help establish the embodiment of sustainable development into the system strategy. Which identifies with "the power of adding, evolving and self-organizing the system structure" Leverage Point 4, which means making new sustainable rules to the procurement process including adding positive or negative loops to the method.

Gateway Review 3: *Investment Decision*

This Gateway confirms that the recommended contract decision is appropriate before the contract is signed with a supplier or partner. It provides assurances on the processes used to select a supplier and it also assesses whether the process has been well managed; whether the business needs are being met. Finally, that both the client and the supplier can implement and manage the proposed solution and that the necessary processes are in place to achieve a successful outcome after contract award.

In this Gateway, two possible Leverage points arise to intervene and integrate sustainable into the system; "the strength of negative feedback loops" Leverage Point 8 as well as "the gain around driving positive feedback loops" Leverage Point 7. Whether the need is to have a self-correcting or self-reinforcing feedback loop, the investment plan can be integrated with both depending on the circumstances of each stage of the investment plan.

Gateway Review 4: *Readiness for service*

This review focuses on whether the solution is robust prior to delivery; how ready the organization is to implement the business changes that occur before and after delivery; and whether there is a system for evaluating ongoing performance.

Leverage Point 9 "the lengths of delays, relative to the rate of system changes" seem the appropriate point to integrate and consider the impact of sustainability key elements on the service and the degree of readiness to go "live" with it. Social, environmental and economic impacts could represent constraints to the rate of changes of the system and allow longer or shorter delays in the feedback loops.

Gateway Review 5: *Evaluate the In-service benefits*

It focuses on ensuring that the project delivers the benefits and value for money identified in the business and benefits plans, as there should be periodic reviews in accordance with planned project reviews and the contract administration arrangements.

For this final stage of Review, the structure is already built and the real Leverage point is in understanding its limitations and bottlenecks and refraining from fluctuations or expansions that strain its capacity. Leverage Point 10 "the structure of material stocks and flows and nodes of intersection" allows us to evaluate the gains and benefits from integrating the sustainability approach into the system form the start as well as establish the guidelines for sustainable approach to operational and occupation phase. Before ending the reviews always allow the team to identify the way forward for further development.

As we go through the five different Gateway Reviews, trying to identify the most efficient Leverage Point for each stage, it is apparent that the further we go into the process; the Leverage Points are the less efficient on the original list. That is absolutely true as we embed Sustainable Development from the early stages of the strategic level of the project, the less we need Leverage Points to intervene in the system in later stages.

When Sustainable Development (SD) is integrated in the system; the purposes of each Gateway would include: -

- Ensuring that SD is implemented and achieved within this stage and thereafter.
- Establishing a list of SD goals and ensuring their feasibility.
- Clarifying the benefits of integrating SD for the initial business case.
- Ensuring that the goals meet/exceed stakeholders' needs and expectations.

The potential for success would include: -

- The social, environmental and economic benefits.
- Confirmations that the SD plans meet the government SD strategy.
- Assuring that SD strategy proposed comply with the overall guidelines for success.

The Way Forward for Project Management

The OGC gateway reviews had obvious potentials to embed a more sustainable approach. Analysing the system and identifying the sustainability gaps was driven by highlighting the leverage points in the system and introducing more social, environment and economic values onto the system. Being a generic procurement model demonstrates and proves that *change* can be achieved and sustainability can be attained.

For project management and the areas of knowledge, *Project Procurement Management* "includes the processes required to acquire goods and services, to attain project scope, from outside the performing organisation". (PMBOK, 2000) It represents a vital management area of knowledge necessary for the delivery of the project scope starting from the strategic level of any project. Identifying the sustainability potentials for this area is demonstrated in Exhibit 3. Applying systems thinking on the OGC procurement model is another demonstration of what the project management profession needs to adopt and underpins the chances we as project management professionals are missing. Embracing sustainable development onto the project management areas of knowledge and processes would display our commitment to change and willingness for a better quality of life.

The way forward is simply in adopting such approach and the creation of new set of project management tools. That would enhance the approach in delivering a more sustainable project management practices. The continuity of research and development of this issue is a global trend that we need to take seriously and in fact start acting on and believing in.

The undergoing PhD research by EID at the University of Edinburgh revolves around recognising the need for adopting sustainable approaches to the project management odyssey fortified by the belief that project management is a significant and undeniable contributor to the construction industry. Systems thinking gave us the chance to understand that implementing sustainability from the early stages of the project would assure a far more efficient and positive impact on the project process and it is successful project management that starts from the strategic levels of project that can represent a solid and fertile ground for such implementations.

The world's commitment to sustainable agendas is the foremost goal of the coming Earth Summit 2002 and it is the author's belief that Project management can contribute to our quality of life and sustainable project management would most certainly contribute to a better quality of our lives.

Conclusion

There are major inefficiencies in the construction process and there is a potential for a much more systemised and integrated project process based on good science and assessment of risk, balancing ecological, economic and social objectives. The construction industry is currently under performing in these objectives, which means a significant opportunity cost associated with unsustainable construction exists.

The adaptation of sustainable construction has been facing a principal barrier that lies with the prevailing business models and project management techniques employed by construction companies. Such models and methods are frequently unresponsive to sustainability drivers and therefore fail to deliver the appropriate business signals to financial planners and other key decision makers, which would otherwise encourage and support investment in more sustainable practises whilst leading to greater market differentiation on quality as well as price.

The business case for sustainable construction has to be identified by all stakeholders and perceived as a better chance for performance. The European Commission has promoted competitiveness as integral to the business case. The author has sought to demonstrate that it is not competitiveness by itself that is the key but the establishment of a vital connection between *sustainability*, *competitiveness* and *Project management* provides the essential link.

The integration of the three factors has been described as a vital and necessary step towards future developments. It has been established in this paper that entrenching sustainability onto the project management processes and areas of knowledge is possible and in effect shows a lot of potentials and opportunities for change.

A new generation of project management techniques and tools is needed to reflect this revolution in approach by thinking and acting sustainably. The specification of such tools is a key objective of the research project currently being undertaken by Eid at the University of Edinburgh.

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List of Exhibits

Exhibit 1: CIB report Workgroup 82 Publication 225, *Sustainable Development and the Future of Construction*. 1998, (p.14)

Exhibit 2: Linking Sustainability to the Key elements of competitiveness.
(Eid, M. and Talbot, R. PMI Europe 2001 Conference, London. Contributing Paper titled “*Rethinking Project Management; The Business Case for Sustainable Construction*”).

Exhibit 3: Mapping of Project Management Processes to Sustainability through Knowledge Areas.
(Eid, M. and Talbot, R. PMI Europe 2001 Conference, London. Contributing Paper titled “*Rethinking Project Management; The Business Case for Sustainable Construction*”).

Exhibit 4: Integrating the Three Elements in Question.
(Eid, M. and Talbot, R. PMI Europe 2001 Conference, London, Conference presentation).

Exhibit 5: The State of the System Diagram.
(Meadows, D., 1999 *Leverage Points: Places to Intervene in a System*).

Exhibit 6: Generic Procurement Project Process (Sustainable Approach)
(Eid, Mohamed, on going PhD Research at the University of Edinburgh due to be finished by early 2003. Thesis titled “*Integrating Sustainable Development and Project Management for Construction Projects*”).