LEAN AND SUSTAINABILITY
How Can They Reinforce Each Other?

by
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Abstract

The purpose of this dissertation is to find out whether sustainability can introduce lean to companies in situations other than a crisis. The project also looks at how lean, as a proven management system, can support sustainability in becoming economically more attractive.

This dissertation starts with an extensive literature review, first about lean, followed by sustainability. It looks at: definitions, reasons why, how to, and barriers. Then a combined literature review focuses on: the communalities, potential conflicts, and how lean and sustainability can support one another. Each chapter concludes with a conceptual framework where findings are summed.

The research approach is both deductive (literature review to develop a theoretical position) and inductive (data collection and analysis). The main research design is an exploratory study based on comparative case studies. For this both a Lean Change Agent and an Environment, Health & Safety Manager were interviewed at three multinationals.

The findings show that lean is mainly used for its practical guidance, by using its tools and techniques, while also helping to make the broad concept of sustainability more tangible. However, without adopting lean's long-term philosophic base, its utilisation remains superficial and is less likely to have a long lasting impact.

Sustainability hardly provides any other incentives for lean than financial ones. Although an extra constancy of purpose is not offered by sustainability, the emerging economic urgency may create a useful tide for lean.

As such this dissertation still provides enough arguments for both lean and sustainability implementers to stand stronger together facing mutual issues.

PREFACE

Lean first gained my attention during Strategic Operations Management (SOM) classes. Because lean thinking matches my way of thinking: Why do something at all?; Think before you start!; and, Use resources respectfully (or: Purpose-Process-People). After working on my SOM assignment, which dealt with lean aspects, I wanted to learn more about this subject. Reading about the huge gains of lean production over mass production in *The Machine That Changed the World* by Womack, Jones and Roos (1990) made a strong impression on me.

However, after reading *Lean Thinking* (Womack and Jones 1996) I noticed that most companies only adopted lean after a crisis. It seemed to me that there would be other ways to introduce lean to organisations, namely not to wait for some crisis, but to use more positive incentives to reap the benefits of lean. The aim was also, hopefully to question why companies seek to move to low-wage countries especially when there is a (lean) way where quality is not a trade-off of cost.

Meanwhile I kept a log for my research ideas. Amongst them were: Incentives to go lean; Why not go lean?; and (although I am not an environmentalist), Lean and sustainable development. Because there is much to do about the environment these days, where waste reduction is a big issue, the combination looked perfect to me. Why not use sustainability (environmental, social and economic) as a strategic incentive for lean management?

After a short search on the internet I found that the Lean Operations Research Center (LO-RC) at the University of Groningen (RUG) had a research theme posted called "lean and sustainability". After contacting Prof. Slomp of the LO-RC, I knew this is still a niche subject.

To shape my thoughts, and to network, I attended the Dutch 2007 Lean Management Summit. I talked to people from some well known internationals (e.g. Heineken, KLM, Stork, Sara Lee) about my research idea. Their reactions were very positive, especially as they never looked at the combination before. I kept in touch, so I could contact them again for my research.

I would like to thank Professor Steve Brown, who firstly inspired me and subsequently supervised my management project. Also thanks to Professor Jannes Slomp who was so kind to discuss some thoughts on the subject with me. And Caroline van Beelen and Giuseppe Marzio for their proof-reading.

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Although there are many others to thank, I would like to give my appreciation to Ting Jiang at TiasNimbas who endlessly supported all of us. You are the straw that many could hold on to when struggling with unexpected circumstances.

Last but not least I would like to thank my girlfriend, and soon to become my wife, Ingeborg. Although I am finished now, she still has another half year of her part-time masters to go. My dear, I will be there for you as well!

PS: Thanks to this project I made implementing the lean philosophy my profession.

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LIST OF ABBREVIATIONS

5S: Sort, Straighten, Scrub, Standardise, and Sustain

BPR: Business Process Reengineering

CSR: Corporate Social Responsibility

DCF: Discounted Cash Flows

EBIT: Earnings Before Interest and Tax

EH&S: Environment, Health & Safety

EMS: Environmental Management System

EPA: U.S. Environmental Protection Agency

EPA-OPEI: EPA's Office of Policy, Economics, and Innovation

GDP: Gross Domestic Product

IRR: Internal Rate of Return

Jidoka: Japanese for in-station quality

JIT: Just-In-Time

Kaikaku: Japanese for radical realignment of the value stream

Kaizen: Japanese for (continuous) improvement

Kanban: Japanese for signboard (visual signal)

MIT: Massachusetts Institute of Technology

Muda: Japanese for waste

SCA: Sustainable Competitive Advantage

SME: Society of Manufacturing Engineers

TPS: Toyota Production System

TQM: Total Quality Management

VSM: Value Stream Mapping

WBCSD: World Business Council for Sustainable Development

WIP: Work-In-Process

1 INTRODUCTION

1.1 How can lean and sustainability leverage each other?

The main reason for companies to apply lean is often based on a negative incentive, like a financial crisis (Womack and Jones 1996). But why wait for some crisis to reap lean's many benefits? Benefits such as: fundamentally increasing competitiveness by utilising resources more effectively, while improving quality, reducing cost, and increasing responsiveness (Larson and Greenwood 2004; Womack and Jones 1996).

These improvements are achieved by a philosophy of continuously attacking non-value adding actions, or 'waste'. This waste elimination is an important commonality with sustainability (EPA 2003; Larson and Greenwood 2004).

Due to environmental changes, sustainability – the integration of environmental, social, and economic goals (Hargroves and Smith 2005) – is a huge topic in business these days (e.g. *The Economist* 2007a, b). According to Porter and Kramer (2006) corporate sustainability will become ever more important to competitive success!

A few companies, such as Ben & Jerry's and the Body Shop, distinguished themselves through their commitment to social responsibility (Porter and Kramer 2006). But the general motivation for sustainability is often just a legal one, a nuisance to maintain legitimacy, perceived as a cost of doing business (Hart and Milstein 2003).

However, it would be better to prevent any constraints and cost caused by regulations. Going the proactive 'green' way can even be profitable. Especially when lean, as a proven management system, can support the sustainability business-case (Gordon 2001). But also the other way around: when a company's sustainability goals are considered along the lean path, lean can be deployed even more usefully.

That is why this project investigates whether sustainability could provide positive incentives to introduce lean management to companies. It will also try to discover whether lean and sustainability would somehow conflict.

This project may contribute to make sustainability economically more interesting by introducing the lean principles. Hence, making lean also known as a 'green solution'. Because lean is well known for improving (economic) sustainable performance, but not that much as an accelerator for (environmental) sustainability. The topicality is a chance to apply lean in another way than usual.

1.2 Contents of this report

This short introduction to the subject is explored in more depth by the literature review, which is a large part of this research project. It starts, in Chapter 2, with explaining the lean principles and its benefits, and explores the reasons for adopting lean thinking. The challenges of deploying lean are also addressed.

Then in Chapter 3, the report defines sustainability and relates it to current business thinking. Therefore the role of Corporate Social Responsibility (CSR) is reviewed as well. Again, the challenges of deploying corporate sustainability are addressed.

Subsequently, in Chapter 4, the relations of both are examined. Looking at where overlaps and gaps lay, but also discovering possible contradictions. Revealing, by this, both possibilities and potential traps.

The methodology is explained in Chapter 5, on basis of the research scope, approach, depth, case selection, and data collection.

Before the results are presented, in Chapter 6, an explanation is provided on how the semi-structured interviews were conducted and analysed. Then the results of the findings are explained.

In Chapter 7 these findings are then compared with the overall research aim. Unexpected findings are discussed as well, followed by possible applications and recommendations.

Finally, in Chapter 8, limitations of the research are pointed out, together with unexpected problems that arose. The report concludes how future research might build on this one.

2 LITERATURE REVIEW – LEAN

2.1 What is lean?

2.1.1 Origins are result of scarce resources

Lean thinking originates from Japanese manufacturers' shop-floors, in particular Toyota, with innovations such as automated mistake proofing, just-in-time (JIT), *kanban* for pull production, and high levels of employee problem-solving (Hines *et al.* 2004; Shingo 1981; Womack *et al.* 1990). This was the result of scarce resources and intense competition in Japans domestic automobile market. Lean operations were designed – as an alternative for the capital intense mass production – to use resources more efficiently and, consequently, to eliminate wasteful non-value adding activities.

Toyota was inspired, however, by Ford's very early mass production system. And also by the American quality gurus Deming and Juran, who found that focusing on quality actually reduced cost more than focusing solely on cost (Hines *et al.* 2004; Liker 2004; Womack *et al.* 1990).

Meanwhile (1970s) the 'secrets' of the lean approach came in the open when supplier manuals about Toyota's Production System (TPS) were produced and translated in English (Hines *et al.* 2004). Finally the performance gap between Western and Japanese manufacturing drew researchers' attention. With the bestseller *The Machine That Changed the World* by Womack, Jones and Roos (1990) – based on MIT's International Motor Vehicle Program research – the world manufacturing community discovered 'lean' production.

Lean, however, is one of the researchers' term for Toyota's way of speeding up the supply chain by focusing on eliminating wasteful process steps. It is therefore not a new paradigm, but rather TPS with modifications even from outside Toyota (Hines *et al.* 2004; Liker 2004; Papadopoulou and Özbayrak 2005).

2.1.2 A long-term philosophy

It is widely acknowledged and emphasised that lean is not a toolbox nor even a system. It's rather a philosophy, based on: the understanding of people and their motivation; leadership cultivation; building teams and relationships; strategy deployment; and

maintaining a learning organisation. This stems from a mutual obligation and contributes to the continuous improvements, and is constantly evolving (Liker 2004; Papadopoulou and Özbayrak 2005; Shingo 1981; Womack *et al.* 1990; Womack and Jones 1996).

Principles: besides process, also purpose and people

Womack and Jones (1996) summarised 'lean thinking' in five principles: value, value stream, flow, pull, and perfection. These principles are, however, quite focused on the process part of lean (and on continuously improving it). According to Liker (2004) most 'lean' companies are stuck there. Liker therefore takes a broader approach by starting with the philosophy, or Deming's "constancy of purpose" (Liker 2004 p.82). He also adds the importance of people and partners, who are needed to take up the challenge and should thus be respected and 'grown'. Both sets of principles can be summarised in the three unity: purpose, process, and people (LEI 2007; Stiles 2008).

Organisational features

According to Womack *et al.* (1990) a truly lean plant therefore has two organisational features: first, the maximum number of tasks and responsibilities within it are transferred to those workers actually adding value; secondly, it has a system for detecting defects and quickly traces the problems to its ultimate cause. The difference between the conventional approach and lean is well summed by Pascal Dennis (2006) in his book *Getting the Rights Things Done*, as shown in Table 2.1 on page 7.

From tools to enterprise

It should be clear that 'lean management' is more than just a set of tools and techniques. It needs a holistic approach, affecting beyond production all operational aspects from design to maintenance, and from the shop-floor to management. A true overall organisational philosophy, rather called 'lean enterprise'. Its strength lies in its evolutionary nature, closely related to the development stages of organisational learning (Hines *et al.* 2004; Papadopoulou and Özbayrak 2005). As such lean is not easily imitated which encouraged observers to deconstruct the system into key elements. But, Lewis stresses, they "inevitably de-emphasised the impact of 30 years of 'trial and error'" (2000 p.963).

2.1.3 Key elements depicted in TPS House

Lean as a philosophy makes the determination of the elements therefore not an easy task (Lewis 2000; Papadopoulou and Özbayrak 2005). For many, lean represents the identification and elimination of all forms of non-value added activities, or waste (Larson and Greenwood 2004). Sometimes lean is referred to as just Total Quality Management (TQM) or JIT, which are – although important – only parts of TPS.

A good way to describe the TPS elements is by depicting them [Figure 2.1] in the 'TPS House'. Because the metaphor of a house clearly shows the need of a solid foundation and interaction of all elements to make it work. No building block can be left out!

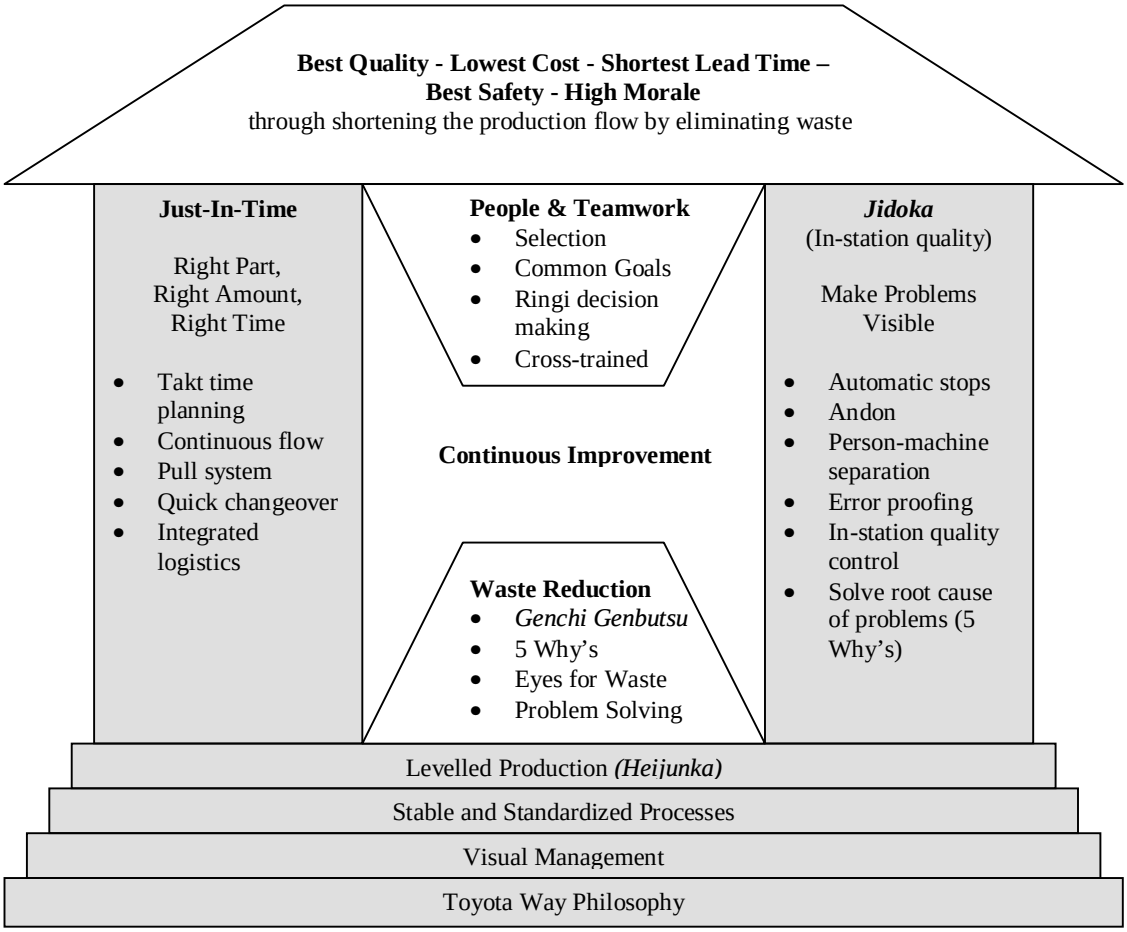


Figure 2.1: The 'building blocks' of the TPS House (adapted from Liker 2004 p.33)

Waste reduction

A basic principle of TPS is the "total elimination of waste" (Shingo 1981 p.xxvii), which are activities that do not add any customer value. The original seven wastes (or

muda) are: defects, overproduction, inventories, unnecessary processing, movement, transportation, and waiting. Of which overproduction is the worst, as this includes in essence all the others. It was therefore the driving force for Toyota's JIT system to eliminate the rest (Womack and Jones 1996).

'Underutilisation of employees' is sometimes added as an eighth waste. Because companies seem to forget that employees come to work everyday not just with a pair of hands, but with a 'free' brain as well (Brown *et al.* 2005; Takeuchi *et al.* 2008). This is an important issue, as organisations can only eliminate waste and continuously improve by embracing the creativity of their employees.

Just-in-time

One of the TPS House pillars is just-in-time (JIT), which is the name for Ohno's production control system – that took him more than twenty years to fully implement – to produce and deliver the right items at the right time in the right amount, to make single piece flow possible (Liker 2004; Womack *et al.* 1990; Womack and Jones 1996). Thus it's not some schedule of 'frequent deliveries' (Womack *et al.* 1990). JIT is often also referred to as 'pull system' (Womack *et al.* 1990). However, this is only one element of the whole JIT system (Liker 2004).

In-station quality

The other pillar is *jidoka* or in-station quality, which in essence means: never let a defect pass to the next step (Liker 2004). This in strong contrast with mass-production where 'quality' is out-the-door-quality, thus after defects are repaired (Womack *et al.* 1990).

Around the 1950s a positive relationship was found between quality deployment and operational and financial performance. As quality drives the value proposition of companies, which is eventually what keeps them in business, TQM is in pursuit of the 'perfect' process (Brown *et al.* 2005; Womack and Jones 1996). Therefore it needs constant attention to the idea that quality is everyone's responsibility (Liker 2004). The basis for these continuous improvements is still Deming's problem-solving cycle (Plan-Do-Check-Act).

2.1.4 Process improvement systems related to and confused with

Other process improvement systems which are often related to and confused with lean are Business Process Reengineering (BPR) and Six Sigma. The first focuses on creating value at disconnected steps, whereas breakthroughs come from looking at the entire value stream (Womack and Jones 1996). Six Sigma tends to focus on fixing the value adding process using complex statistical tooling, whereas Toyota keeps things simple, and problem solving is 20% tools and 80% thinking (Liker 2004). This report only relates to lean.

Table 2.1: Conventional versus lean mental models (adapted from Dennis 2006 pp.24-5)

Conventional approach	*Lean mental models*
• Thou must! Leader = dictator. • The shop floor only gets comments. • We have a few standards, but I don't know exactly where they are, nor if we stick to them. • Let the conveyor run. Produce as much as you can. • Make sure you don't get blamed. • Specialists solve problems using complex methods.	• What do you think? Leader = teacher. • Go see for yourself. • We have simple, visual standards for all important processes. • Stop the production so that the production won't stop you. Don't deliver garbage. • Make problems visible. • Everyone solves problems using simple methods.

2.2 Limitations and criticism

In its development over time critics, either from within or outside the lean movement, have pointed to various 'gaps' in lean. However, these gaps changed as lean thinking evolved (Papadopoulou and Özbayrak 2005), mainly driven by surfacing shortcomings as more organisations learned about it. As well as from the extension into new sectors with different settings and constraints (Hines *et al.* 2004).

2.2.1 Lack of consideration of human aspects?

According to Hines *et al.* (2004) some viewed lean as exploitative, with high pressure on the shop floor workers. But this simultaneously raised the issue that the human dimensions, such as motivation, empowerment and respect, are very important. As these elements are key to the long-term sustainability of any lean programme, they make it more than just a set of tools and techniques. Takeuchi *et al.* (2008) also strongly conclude that at a true lean company humans are placed at the centre to drive the culture of contradictions.

2.2.2 Missing early and late material flow stages?

According to Larson and Greenwood (2004) lean tends to focus on the middle part of the value chain (direct suppliers, own transformation processes, and customers' product use) and therefore misses very early (energy and material extractive) and late (ultimate product and non-product output disposition) material flow stages. They say this limits lean's capacity for fully optimising its product and process redesign initiatives from the perspective of a full product life cycle. Papadopoulou and Özbayrak (2005) report however that across a lean enterprise 'integrated product/process design' teams are organised to ensure concurrency throughout the overall product life cycle.

2.2.3 No explicit attention to (low cost) ecological risk

Lean also appears to pay limited or no explicit attention to the ecological risks. In cases where environmental cost are relatively low, lean is likely to skip right over a risky material and focuses its efficiency efforts on areas of higher cost (EPA 2003; Larson and Greenwood 2004). This is plausible, as Shingo (1981 p.xxii) reports that "[TPS] makes improvements in that area in which the greatest cost reductions can be made."

2.3 Why do companies take the lean path?

Many researchers (Hines *et al.* 2004; Liker 2004; Womack *et al.* 1990) acknowledge that the transformation towards a lean enterprise requires a lot of dedication and everyone's participation to introduce the new principles in the company culture and organisational structure. Then what makes lean worth all this effort and leaves so many companies struggling?

2.3.1 Increase competitiveness with quality, cost and delivery

The driving force for the transition towards lean is to fundamentally increase its competitiveness by utilising available resources more effectively, while improving product quality, reducing capital and operating cost, and increasing responsiveness, with the ultimate goal of improving customer satisfaction (Koechlin and Müller 1992; Larson and Greenwood 2004; Papadopoulou and Özbayrak 2005).

Also an *Industry Week's* survey (Blanchard 2007) shows that the main reason for process improvement is high quality (74%). Fast delivery comes fourth (32%) and lowest cost only seventh (27%), but on the rise. Service and support (56%) and total value (41%) come second and third. The catalytic force however, Womack and Jones note, is "often a moment of profound crisis" (1996 p.97).

Clear benefits

Based on years of benchmarking Womack and Jones (1996) developed the following rules of thumb. Shifting from classic batch-and-queue towards continuous-flow (i.e. lean) doubles labour productivity, while rework, job injuries, and time-to-market, are cut in half. Both throughput times and inventories are even slashed by 90%! And all this can be achieved with little (even negative) capital investments, as reduced inventory and facility space free up cash.

These are just the initial effects of the radical realignment of the value stream (*kaikaku*). Further continuous improvements (using *kaizen*) can double productivity and halve inventories, errors, and lead times again within three years. When pursuing 'perfection' both can then produce endless improvements (Womack and Jones 1996).

> Our conclusion is simple: Lean production is a superior way for humans to make things. It provides better products in wider variety at lower cost. Equally important, it provides more challenging and fulfilling work for employees at every level, from the factory to headquarters.
>
> (Womack *et al.* 1990 p.231)

2.3.2 Environmental awareness reason for improving efficiency

Blanchard (2007) finds it not surprising – given the increasing awareness of 'green manufacturing' – that the biggest percentage increase (up 11%) is in environmental management practices (44%) and energy management (up 9% to 33%). However, new and already second most important are recycling and reuse programs (56%). Therefore it can be stated that environmental issues provide emerging reasons for improving efficiency, hence to engage in lean.

2.4 How can companies make lean successful?

2.4.1 Commitment from the very top

As with any change, the first prerequisite to successfully implement and sustain lean is the commitment from the very top. Because such a change, with the emphasis on the company-wide culture, is essential for the whole business (Balogun and Haily 2004; Papadopoulou and Özbayrak 2005).

2.4.2 Management system with clear responsibilities to penetrate culture

Before thinking about any specific lean techniques, Toyota first concentrated on the management system to let the TPS philosophy penetrate the organisation's culture. This in contrast with most of their emulators (Liker 2004; Papadopoulou and Özbayrak 2005; Womack 2007). Within the system it must be clear who is responsible for the state of each value stream, which includes the many support streams supplying the needed human resources, materials, process technology, and methods (Womack 2007).

2.4.3 Policy deployment: clear communication of strategic goals

For a lean transformation top management needs to implement their strategy, referred to as 'policy deployment'. The strategic and philosophic company goals ('true north') and supporting department goals must be stated as clear objectives with a deadline and must be assigned to someone. These are subsequently presented on an A3 planning board with a current state and future state, and the resulting actions (Dennis 2006; Womack and Jones 1996).

As transparency in everything is a key principle (Womack and Jones 1996; Takeuchi *et al.* 2008) this planning needs to be highly understandable and visible to everyone! This then leaves no room for ambiguity about what needs to be done, therefore removing fear and anxiety which improves the chances of a lasting change (Papadopoulou and Özbayrak 2005). The management process itself is also based on the Plan-Do-Check-Act cycle for continuous improvement (Dennis 2006; Womack and Jones 1996).

2.4.4 Brilliant processes lead to an SCA

Rather than developing precise metrics for managers to meet at the end of the reporting period – equivalent to 'end-of the-line' quality inspection, Toyota focuses on having 'brilliant' processes. They do so, because the fundamental belief is that when the process is right, the results will be right (Womack 2007). Therefore at the heart of the lean process model is developing increasingly efficient and reliable routines, with its emphasis on perfection through continuous improvement (Lewis 2000).

In turn these processes allow the organisation to learn and thereby reinforce existing or even create new resources. If a company does this better than its competitive environment, a sustainable competitive advantage (SCA) can be derived. As such, a business is either a very capable player in its market (being better or lower cost) and/or being differentiated in what it offers (Grant 2008; Lewis 2000). The advice from Womack and Jones (1996 p.49) is therefore simple: "To hell with competitors, compete against perfection!"

> We get brilliant results from 'average' people managing brilliant processes. We observe that our competitors often get average (or worse) results from brilliant people managing broken processes.
>
> (Taiichi Ohno in LEI 2007 p.4)

2.4.5 Empowerment and teamwork, supported by new HRM policies

As lean is based on the principles of continuous improvement, workers are responsible for identifying problems, and stop the process, for solving them on the spot. Therefore they need empowerment and ownership for the improvement. This may be more stressful, but it also means freedom to control one's own work. And it needs far more professional skills to be creatively applied in a team setting (Papadopoulou and Özbayrak 2005; Rothenberg *et al.* 2001; Womack *et al.* 1990).

As worker commitment, motivation, and skills are crucial for success, companies need to enhance their personnel systems and career paths. Workers need an aptitude and ability to work in a cooperative fashion, which requires: fairly restrictive worker selection; high levels of training and skill development; compensation linked to group performance; and reduced status barriers between managers and workers (Rothenberg *et al.* 2001; Womack *et al.* 1990; Womack and Jones 1996).

2.5 Why do so many struggle with their lean transformation?

Industry Week's survey shows that nearly 70% of all U.S. plants have adopted lean manufacturing as an improvement methodology. Contrasting its popularity is its implementation success. As figures at the same survey show that only 25% make significant progress, and nearly 2% report having achieved a 'World Class' status (Blanchard 2007). This leaves three quarters struggling with their lean transformation. Although, Rubrich (2004) warns, this might stem from a learning curve effect, the question arises: What makes it so difficult to implement?

2.5.1 Focusing too heavily on tools

Shingo (1981 p.xxii) warned already that it is "risky to implement [TPS] by merely copying superficial techniques." Which is exactly the reason why many companies fail at their lean implementation: they are stuck at the process part, too heavily focusing on tools. But these tools and techniques are not the key to sustain change! Lean needs a holistic approach where the entire system becomes part of the organisation's culture (Hines *et al.* 2004; Liker 2004; Papadopoulou and Özbayrak 2005; Womack 2007). This also explains why concepts such as 'pull' and *kanban* are easily misunderstood (Hines *et al.* 2004; Shingo 1981).

2.5.2 Long-term commitment missing due to lack of management involvement

The required long-term commitment is mostly missing, because senior management is often not involved in daily improvements that are part of lean (Liker 2004). That's why they fail to make lean a company-wide culture (Papadopoulou and Özbayrak 2005). This culture of 'reciprocal obligation' is highly needed to create a willingness to participate and initiate continuous improvements (Womack *et al.* 1990).

2.5.3 Short-term 'solution' of just cost cutting

A mistaken perception of lean is that its main benefits come from cost cutting (Rubrich 2004; Womack 2007). But, headcount reduction, for example, is detrimental as it demoralises people. It is a short-term 'solution' as it does not get to the root cause (Rubrich 2004). Toyota's success, however, stems from a deeper philosophy based on human motivation (Liker 2004; Papadopoulou and Özbayrak 2005).

2.5.4 No sense of urgency

Although not many organisations adopt lean thinking without a crisis (Womack and Jones 1996), some do. But when there is no sense of urgency, it is hard to create readiness for change (Rubrich 2004). Where in a matter of survival, people seem to overcome their reluctance to change (Balogun and Hailey 2004).

> A booming business is exactly the environment that leads many companies into complacency. But the biggest crisis, from the perspective of Toyota leaders, is when associates do not believe there is a crisis or do not feel the urgency to continuously improve the way they work.
>
> (Liker 2004 p.51)

2.5.5 Underestimated need for HRM

To create this willingness to participate, companies often forget about their personnel systems and career paths (Womack *et al.* 1990). The success of the lean transformation, however, depends on everyone along the value stream to believe the new system treats everyone in a fair way (Womack and Jones 1996). Especially where responsibilities are pushed down, although they create some freedom they also raise anxiety about making costly mistakes (Womack *et al.* 1990).

2.5.6 Traditional accounting gives wrong signals and incentives

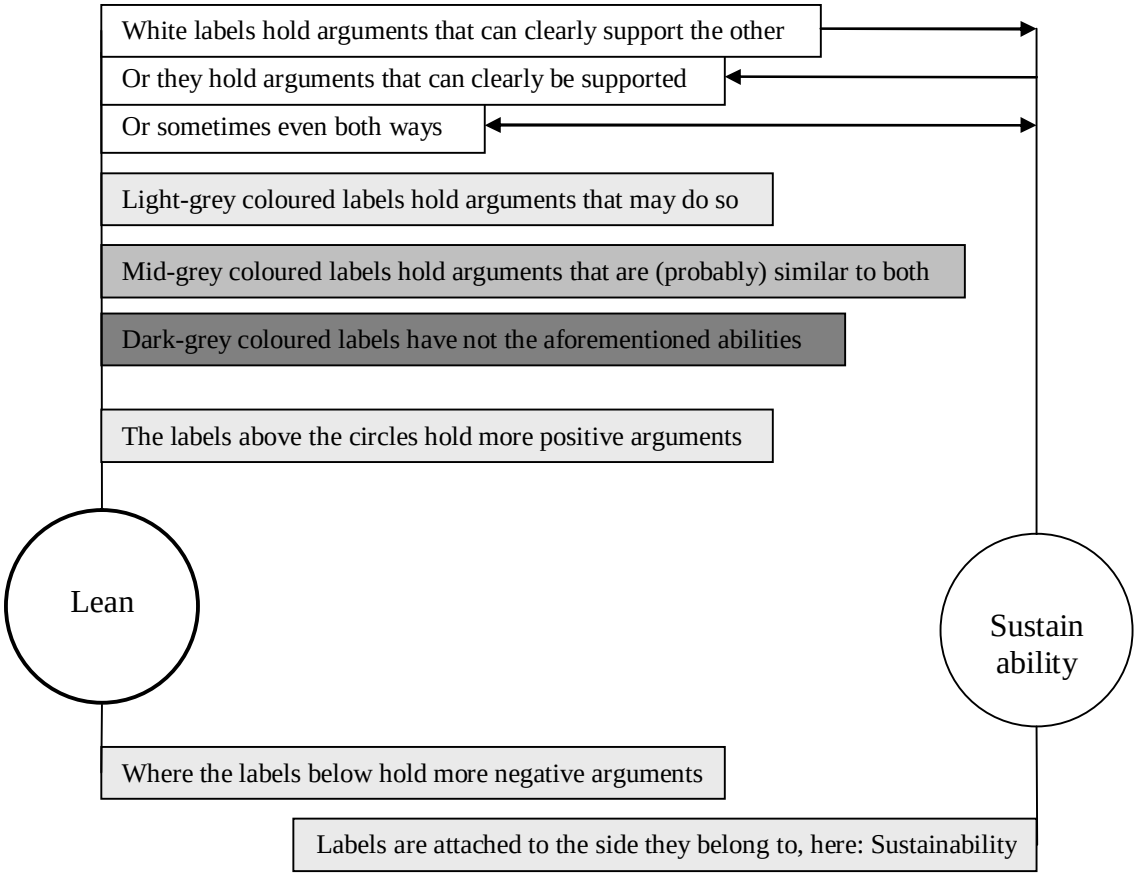
Finally, the traditional way of cost accounting, which allocates cost by machine and labour hours, gives the wrong incentive to 'make the numbers' by keeping machines busy. This overproduction creates inventory that maybe nobody ever wants (Womack and Jones 1996), which is a pure waste of materials, time, and money.

When implementing lean, things will happen to the balance sheet that many financial officers may not like. Because lowering the level of inventories, normally seen as assets but which are truly liabilities, will negatively effect the EBIT. Then it's even more important to look at the cash flow. Because lowering inventory will eventually positively affect the latter (Dennis 2006; Womack and Jones 1996). Therefore Womack and Jones (1996) strongly recommend involving the CFO before any improvements are made, and gradually transiting to the lean approach of cost accounting.

2.6 Concluding lean arguments in conceptual framework

The reasons why, how to, barriers and criticism, are summed in a conceptual framework (Saunders *et al.* 2007 p.489), as depicted on the next page [Figure 2.2].

Legend:



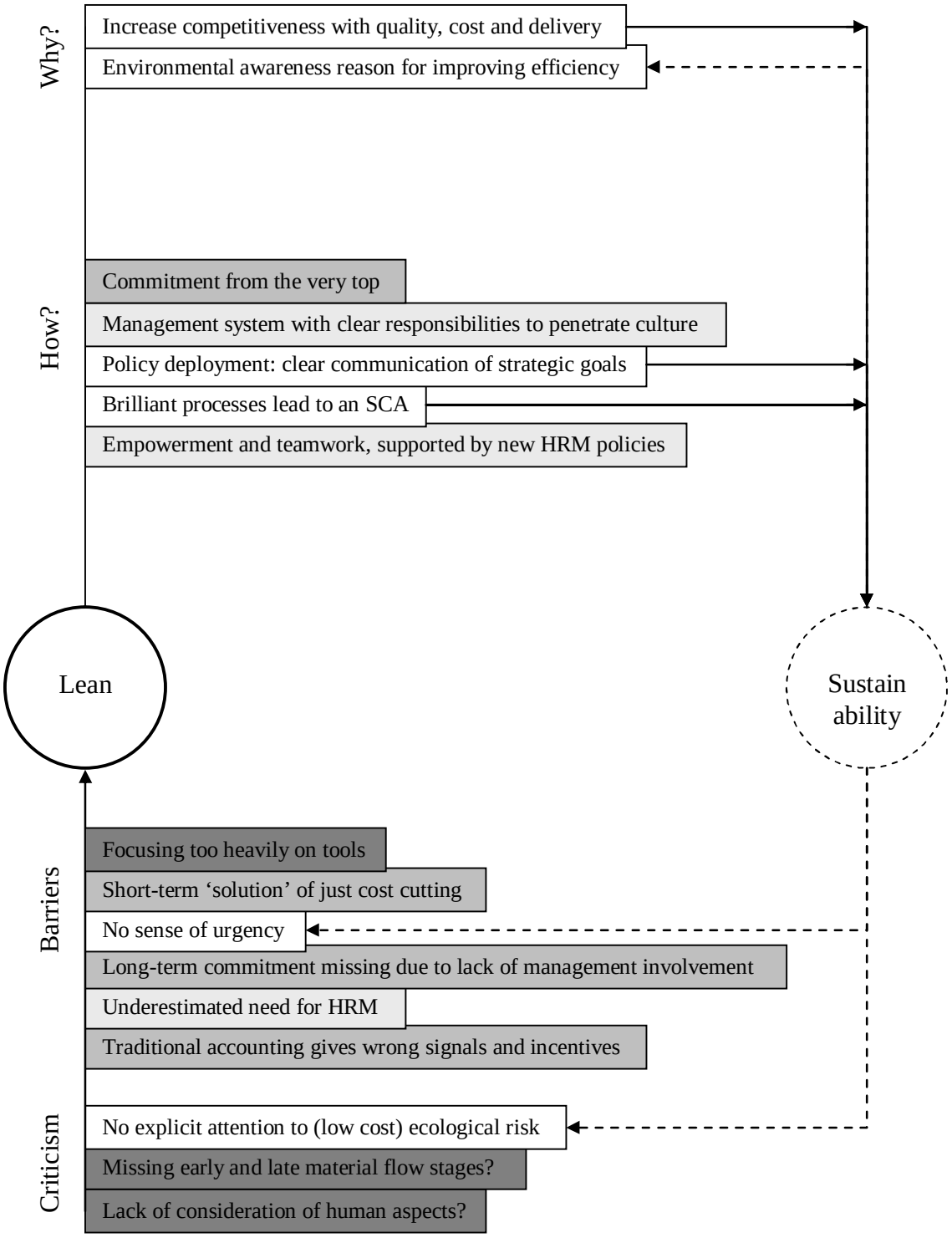


Figure 2.2: Conceptual framework with lean arguments

3 LITERATURE REVIEW – SUSTAINABILITY

3.1 What is sustainability?

3.1.1 The tripe-bottom-line of people, planet, and profit

Sustainability is the often used abbreviated term for sustainable development (Brown *et al.* 2005). Sustainable development was coined in the late 1980s by the Norwegian Prime Minister Brundtland as "Meeting the needs of the present without compromising the ability of future generations to meet their own needs" (UNWCED 1987 p.1) and now used by the World Business Council for Sustainable Development (WBCSD) and many others.

In general, sustainability is a characteristic of a state that can be maintained indefinitely at a certain level (SME 2008). Some (Grayson *et al.* 2008; Brassington and Pettitt 2005) exchange sustainability with its alter-ego corporate social responsibility (CSR). Therefore all these terms are also used interrelated in this paper.

The principle of sustainability is not just an environmental one, but is about simultaneously delivering social and economic benefits (Brassington and Pettitt 2005; Gilligan and Wilson 2003; Grayson *et al.* 2008). That's why this concern about the planet, people, and profit is also called the 'triple-bottom-line' (Hart and Milstein 2003; Porter and Kramer 2006).

3.2 Topicality of sustainability

Since every company wants to tell the world about their good citizenship, sustainability is hard to avoid nowadays (*The Economist* 2008). Koechlin and Müller noted already in 1992 that sustainability is becoming an issue when products are scrutinised, disposal cost rise, recycling systems are started, substitute products appear, legislation becomes tighter, and competitors go for 'green' marketing.

3.2.1 Renewed attention due to scandals and climate

The concept of sustainability is not new. Peter Drucker first identified public responsibility some 50 years ago (Gilligan and Wilson 2003). And an international think-tank recognised already three decades ago that depletion of earth's natural

resources at the current rate would eventually lead to severe economic fallout (Grayson *et al.* 2008). The past few years however it has received much more attention, but with greater emphasis to the impact upon society.

Scandals and climate change prompted calls for government action

This renewed attention is partly a reaction against unbridled maximisation of shareholder value, highlighted by scandals such as Enron in 2001. Especially after seeing the effects of hurricane Katrina in 2005, everyone wants to sustain their company and the world. Our awareness of earth's fragile ecosystem was further stimulated by Al Gore's 2006 award winning film *An Inconvenient Truth*, which subsequently prompted calls for more government action in regard to the climate.

3.3 Why do companies pursue sustainability?

Although there is a broad consensus on terminology, managers still seem to disagree on the motivation for sustainability, differing from a moral mandate, to legal requirement, and a cost for the right to operate. Many firms see sustainability, therefore, as a nuisance (Hart and Milstein 2003). Then why would a company get into sustainability?

3.3.1 License to operate needed

In practice few big companies can now afford to ignore sustainability and justify their actions on the basis of shareholder return (*The Economist* 2008; Grayson *et al.* 2008). Even worse, firms that do not involve in CSR may even risk their very existence (Hart and Milstein 2003; Porter and Kramer 2006; Zadek 2004). Increasingly stringent regulations can make irresponsible companies eventually lose their license to operate (Lovins *et al.* 1999; Porter and Kramer 2006). Hence, sustainability can mean the difference between receiving permits or not (Langenwalter 2006).

3.3.2 Scarce resources and rising prices are limiting growth

The assumptions in the old business model were: resources are abundant and cheap but people are scarce; and damage to the ecosystem does not affect production or increase cost (Langenwalter 2006; Lovins *et al.* 1999; SME 2008).

But resource prices went through the roof! Wheat and oil are 4.5 times more expensive in 2008 than they were in 1990. Copper and coal 3 times, and corn 2.5 times (SME 2008). This is the result, SME note, of our rapidly increasing resource use, due to the growth in population (doubled since 1960) and rising affluence (GDP per person).

> If everyone lived up to the U.S. consumption level, we would require the resources of five earths.
>
> (Langenwalter 2006 p.7)

These shortages of natural resources are now becoming the limiting factor to growth. And economising on the scarcest resource stays logical. Especially because these biological limiting factors cannot (easily) be substituted, unlike in the industrial system where we can easily replace machinery back by labour (Lovins *et al.* 1999). Anyway, there is plenty of room for improvement as only six per cent of materials actually end up in products (Langenwalter 2006).

3.3.3 Financial and associated benefits

The strive for growth is the strongest internal incentive to pursue environmental management, noted by Adachi already in 1992, as it means becoming more cost effective, hence more efficient. This is stimulated by integrated environmental cost and economic instruments (e.g. carbon tax) as it is in every company's interest to pay as little as possible (Koechlin and Müller 1992). The old view of pollution as a "cost of doing business" currently shifts in favour of "prevention at the source", called eco-efficiency (EPA 2000 p.33).

One could raise the question: Why *not* pursue sustainability? Because it does not inhibit growth (Grayson *et al.* 2008) and investors see it as acceptable overhead cost (Zadek 2004). Many executives believe even real business value can be derived from a sustainability strategy (Lovins *et al.* 1999). The reduced operating costs are often reflected in the stock performance, where 'stakeholder-balanced companies' outperform the general market (Grayson *et al.* 2008; Joly 1992; Langenwalter 2006). Therefore Gilligan and Wilson (2003) as well as Porter and Kramer (2006) are convinced that CSR will become increasingly important to competitive success.

3.3.4 Building a competitive advantage

Case studies show that companies that do pursue eco-efficiency even tend to gain a competitive edge (Lovins *et al.* 1999). Not only because efficient organisations will be able to prevail over stronger competition (Koechlin and Müller 1992), or since 'green' products designed to meet customer needs do sell well (Gordon 2001). But especially because sustainable companies that favour tighter environmental and social regulations can seriously damage competitors (Adachi 1992; Langenwalter 2006). Besides, companies focused on the triple-bottom-line attract long-term partners as they have a lower credit risk, hence a better chance of enduring (Langenwalter 2006).

3.3.5 Reputation management for outside and inside the company

Scandals have undermined trust in companies, so they have to work harder now to protect their reputation and the environment in which they do business. Especially as governments are seeking to hold companies accountable, partly by extended reporting (*The Economist* 2008; Langenwalter 2006; Porter and Kramer 2006; Zadek 2004). CSR performance rankings attract considerable publicity and have pushed firms to look beyond shareholder value (Grayson *et al.* 2008; Porter and Kramer 2006).

Many companies also discover that the public perception of corporate social irresponsibility aversely affects sales (Gordon 2001; Lovins *et al.* 1999). Because customers, both consumers and business-to-business, nowadays prefer brands that can demonstrate their sustainability credentials (Brassington and Pettitt 2005; Gilligan and Wilson 2003; Grayson *et al.* 2008). Firms even face a strong demand for CSR from their employees, making it a rationale to help motivate, attract and retain staff (*The Economist* 2008).

3.4 How can companies make sustainability profitable?

Grayson *et al.* (2008) warn us that sustainability is not an objective, but a journey where the business undergoes a radical transformation. Although, they argue, it does not require so much re-engineering of the corporate structure, but rather a radical change in strategic approaches or business model. According to Michael Porter building value with CSR just needs a leap of faith (*The Economist* 2008). What else is needed?

3.4.1 From cost thinking to opportunity thinking

For CSR to work the corporate mindset needs to change (*The Economist* 2008; Grayson *et al.* 2008; Zadek 2004). The essential way to look at CSR, Porter and Kramer (2006 p.83) argue, "is not whether a cause is worthy but whether it presents an opportunity to create shared value." But to Zadek (2004) 'chances' to make responsible money must be created, not found. Although, opportunities are widely presented by increasing consumer attention, criticism, liabilities, and regulations. Therefore an often used strategy to gain a competitive edge is to promote tougher environmental standards trying to hinder competitors (Adachi 1992).

> You can't solve current problems with current thinking. Current problems are the result of current thinking.
>
> (Albert Einstein)

Change business model to a solution-based one

CSR can also help companies to create value by turning it into a central part of their offering and identity (*The Economist* 2008; Grayson *et al.* 2008; Hart and Milstein 2003; Porter and Kramer 2006). Business models may change towards a solutions-based one, where value is delivered by extending services. For example, rather than selling heaters or air conditioners one can lease 'comfort' instead. This is after all what customers are looking for. For that, companies need to rethink their mission. In fact, their business shifts from "the acquisition of goods" towards "continuous satisfaction of changing expectations for quality, utility, and performance" (Lovins *et al.* 1999 p.148).

3.4.2 Use financial benefits as incentive

Financial benefits should be used as an incentive because "money is a capitalist tool for achieving social and ethical goals" (Forbes paraphrased by Joly 1992 p.152). But, to obtain management approval for environmental improvements more easily, one needs to speak the business language. Thus, make a business-case by pointing out, for example: where non-green practices increase expenses, hinder sales, or increase risks. Or point at increased efficiency, saving cost in: waste management, purchasing, packaging, and insurances. Environmental projects may even have lower payback or IRR hurdles, which makes the case easier (Gordon 2001; Koechlin and Müller 1992).

3.4.3 Profit does not motivate, but 'big, hairy, audacious goals' do!

However, the most consistently successful companies in terms of profits and shareholder value tend to be those that are motivated by factors other than profit (Grant 2008). Similarly, conventional management strategies solely based on business cases, forecasting, and cost/benefit analyses, do not take a business very far in their CSR journey. Many (Gordon 2001; Grant 2008; Grayson *et al.* 2008) also argue that the real drivers for sustained corporate success stem from strategic intent, vision, and 'big, hairy, audacious goals', such as 'zero waste'.

> Profits are to business as breathing is to life. Breathing is essential to life, but is not the purpose for living. Similarly, profits are essential for the existence of the corporation, but they are not the reason for its existence.
>
> (Grant 2008 p.54)

Use employee motivation

It is argued that employee perceptions of CSR have a profound effect on job satisfaction, commitment, behaviour, and performance. Because employees take pride in their company's positive CSR involvement, which attracts and retains them (*The Economist* 2008; Porter and Kramer 2006; Rupp *et al.* 2006). Employees may also feel that their organisation has concern for them too (Rupp *et al.* 2006).

3.4.4 Change metrics and incentives

The clear use of metrics and incentives to help affect change can yield considerable benefits (Balogun and Haily 2004; Gordon 2001; Grayson *et al.* 2008; Koechlin and Müller 1992; Porter and Kramer 2006; Zadek 2004). Since: if you can't measure it, you can't manage it!

To translate environmental words into actions the implementation of an environmental management system (EMS) is suggested. It describes the cost savings, or revenue gain, of each activity so that management becomes aware that environmental steps do make business sense, while it prevents them to divert from their long-term goals (EPA 2000; Gordon 2001; Koechlin and Müller 1992). To encourage collaboration, Gordon (2001) suggests making sustainability part of employees' standard performance expectations and creating employee incentives.

3.4.5 Use regular business frameworks

Several strategist argue to use regular business frameworks for analysing social responsibility prospects. So why reinvent the wheel?

Porter's Value Chain

Porter and Kramer (2006) suggest, not surprisingly, using Porter's Value Chain to systematically identify the social impacts of activities. Koechlin and Müller (1992) also suggest it, as it already includes the ecological dimension such as: obtaining raw materials, product development, materials procurement, production, marketing and logistics, up to waste disposal. Besides that, it can reveal links to other environmental problems and possibilities.

Balanced Scorecard

Others (Balogun and Haily 2004; Grayson *et al.* 2008) suggest the Balanced Scorecard, or a broader sustainability version, which helps to achieve strategic alignment by linking strategic objectives with measures and actions.

Portfolio matrix

Hart and Milstein (2003) suggest a portfolio matrix approach. The vertical axis is divided in today's short-term results and tomorrow's future growth. Horizontally they pitch the internal development of organisational skills and capabilities against the external openness towards new perspectives and knowledge. To maximise shareholder value, they argue, firms must perform well simultaneously in all four quadrants to prevent suboptimal performance or even failure.

3.4.6 Integrate in core business: learn from quality movement

By addressing all three elements of the triple-bottom-line, companies can become successful and profitable, and simultaneously become more agile and innovative. To make this to happen they should stop thinking of 'the environment' and 'profitability' as two separate entities (Gordon 2001). Many (EPA 2000; Gordon 2001; Grayson *et al.* 2008; Hart and Milstein 2003; Porter and Kramer 2006) therefore strongly suggest to ingrain sustainability into the company's vision, strategy, and every part of the business.

Although this may sound very easy, according to the EPA (2000) the integration will require fundamental changes in core business processes such as: product development, marketing and sales, manufacturing, supply chain management, and customer service!

Make environmental conservation everyone's concern, just like quality

A parallel is often made with the 1970s introduction of the quality concept. Now we can replace the word 'quality' by 'environmental conservation' to integrate it into every aspect of doing business (Gordon 2001). TQM, however, was only accepted in companies that succeeded in making quality a matter of concern to all their personnel (Koechlin and Müller 1992). This same way, CSR can also become hard to distinguish from a company's day-to-day business.

3.4.7 Efficiency at the source: design for the environment

Saving resources not only pays for itself, but often reduces initial capital investments as well (Lovins *et al.* 1999). The best way to do this, as some late 1990s case studies demonstrated, is at the design stage and production process. This generally improves productivity, reduces operating cost, and may even increase market share (EPA 2000; Lovins *et al.* 1999).

That's why companies should study the supply chain more thoroughly. Especially as green substitutes may be needed, which sometimes simply cost more. Then it is important to involve suppliers, who can help to meet cost reduction goals, and look together beyond the one business deal (Gordon 2001). For this, some (Zadek 2004; Lovins *et al.* 1999) see the move to lean manufacturing as a logical step.

3.5 What slows the adoption of sustainability?

3.5.1 No crisis, since reputational damages hardly effect performance

There is no readiness for change because companies often see no crisis. Since reputational damages rarely cause measurable long-term damage to a fundamentally strong business, especially as short-term performance variations are normal business effects (Zadek 2004). And companies do not get into something painful and risky like change when there is no obvious need (Balogun and Haily 2004).

3.5.2 Sustainability seen as a nuisance

Besides, managers often see sustainability as a nuisance, involving regulations, extra cost, and liabilities, instead of an opportunity (Hart and Milstein 2003). And it disrupts operations, products, or organisational culture, which make the business-case even less compelling (Larson and Greenwood 2004).

3.5.3 Uncoordinated actions disconnected from strategy

Moreover, CSR is such a wide-ranging and fuzzy subject that many companies find it hard to choose where to start and what to focus on (*The Economist* 2008). This might stem from the issue that sustainability is still relatively early in its adoption cycle, like JIT in the 1980s (Langenwalter 2006).

Anyhow, it often results in uncoordinated 'philanthropic' activities, not contributing to a firm's competitiveness or making any meaningful social impact (Porter and Kramer 2006). It is therefore a challenge to align these disconnected ground level activities with overall organisational goals (Grayson *et al.* 2008). Still then, Porter and Kramer (2006) warn, efforts are hardly productive due to the often generic approach.

3.5.4 Conflicting views: economic versus social entity

Another problem is that most approaches focus on the tension between business and society rather than on their interdependence (Porter and Kramer 2006). This may well be the result of the first of two conflicting views: the 'property conception' versus the 'social entity conception'. At the former the firm is seen as a collection of assets owned by the stockholders. But at the latter as a "community of individuals that is sustained and supported by its relationships with its social, political, economic, and natural environment" (Grant 2008 p.57). Or as Porter describes it:

> The conflict between environmental protection and economic competitiveness is a false dichotomy. It stems from a narrow view of the sources of prosperity, and a static view of competition.
>
> (Porter 1991 p.168)

3.5.5 Hard to quantify, but once also 'quality could not be measured'

The root of all barriers however, according to Grayson *et al.* (2008), is the uncertainty whether sustainability really makes a change for the better. Better image, more credibility, and better relationships with customers, future employees, public authorities and other stakeholders are difficult to quantify (Grayson *et al.* 2008; Koechlin and Müller 1992; Larson and Greenwood 2004). Even for those who "distinguished themselves through an extraordinary long-term commitment to social responsibility", such as Ben & Jerry's and the Body Shop, the social impact achieved is hard to determine (Porter and Kramer 2006 pp.81-2).

Without quantifiable benefits, CSR is easily discharged by a new management or another swing in the business cycle (Porter and Kramer 2006). Maybe also because stakeholders' expectations, about what companies can do to address complex societal issues, are too high (Zadek 2004). Zadek concludes: there is no universal business case. But, Grayson *et al.* 2008 reason, when comparing sustainability now with the early days of TQM – suffering from the criticism that 'quality could not be measured' – there is reason to believe that useful metrics will be developed soon.

3.5.6 Competing strategic priorities, too focused on short-term profits

A survey among CEOs found that competing strategic priorities is their biggest barrier to systemically implement sustainability (Grayson *et al.* 2008). Companies hold back to fully engage into CSR because it hardly delivers to the financial bottom line in the short term, the average investors' focus (Hart and Milstein 2003; Zadek 2004). As a result, demands for short-term profits push longer-term innovations down the list (Grayson *et al.* 2008), where eco-efficiency investments have to compete against other investments available (Larson and Greenwood 2004).

According to Grant (2008) there are two problems with this obsession with profitability. First, it blinds managers for the real drivers of superior performance. Secondly, the objective unlikely inspires employees and other company stakeholders.

3.5.7 Perverse incentives create corporate rigidity

Ingrained corporate mindsets, that served well in different times, suppress the reason to change (Grayson *et al.* 2008; Hart and Milstein 2003). These rigidities often lay in the

old performance indicators used. Wrong incentives can then undermine the new sustainable thinking, for example when procurement is still stimulated to order as large and cheap as possible quantities so they hit their targets and bonuses (Balogun and Haily 2004; Liker 2004; Lovins *et al.* 1999; Zadek 2004). Then once again the tensions, between short-term financial goals and its longer-term strategic needs, become apparent.

3.5.8 Classic financial accounting hides the truth

The fear is often that environmental concerns take resources away from the business focus, and lower profit margins (Gordon 2001). Decision makers often also assume that sustainability initiatives have a low financial return, although the payback period often is within 6 to 12 months (Langenwalter 2006). How come?

Discounted cash flows lower the financial effects, not the environmental ones

Because good environmental management involves long-term thinking, distant future liabilities become of low value due to the effect of discounted cash flows (DCF), where the value of cash is discounted by time (Koechlin and Müller 1992). However, DCF do not lower the environmental effects!

Accounting systems hide the truth

Many supply chain managers do not focus on environmental concerns, because cost accounting systems tend to hide the environmental cost that companies incur (EPA 2000; Lovins *et al.* 1999). This distortion is partly a result from the way expenses and savings are booked. Where, for example, inventories are booked as 'assets' while they are actually liabilities (Lovins *et al.* 1999).

3.5.9 Extra complexity by extended external focus

Managers of the core business always end up being responsible for a problem and its solution (Zadek 2004). But, they now have to take a fundamental look at and understanding of the whole, extra complex, value chain (Brassington and Pettitt 2005; Grayson *et al.* 2008; Porter and Kramer 2006). Especially as managers also have to engage with local communities, NGOs, governments, and even competitors (Grayson *et al.* 2008).

The pressure for operations managers mainly will be greater than ever, because their strategy must be in place to enable the firm to deal with the changes (Brown *et al.* 2005). But, most environmental activities are under their control due to the operational side of it, which make these activities – considered the responsibility of EH&S – easily overlooked (EPA 2000).

3.5.10 Different global standards

A more global barrier stems from the difference in levels of development around the world. Many developing nations find it unfair to bare far higher social and environmental standards than the West adopted at a comparable stage in its industrialisation (Grayson *et al.* 2008). However, we are far more knowledgeable now than back then and ought not to make the same mistakes twice. Therefore, instead of imposing, the West should help and share the burden.

Other global challenges come from differing cultural values and legal systems. A phenomenon like child labour may be totally unacceptable in many parts of the world, but necessary to survive in others (Grayson *et al.* 2008).

3.6 Concluding sustainability arguments in conceptual framework

The reasons why, how to, and barriers, are summed in a conceptual framework, as depicted on the next page [Figure 3.1]. The legend can be found on page 14.

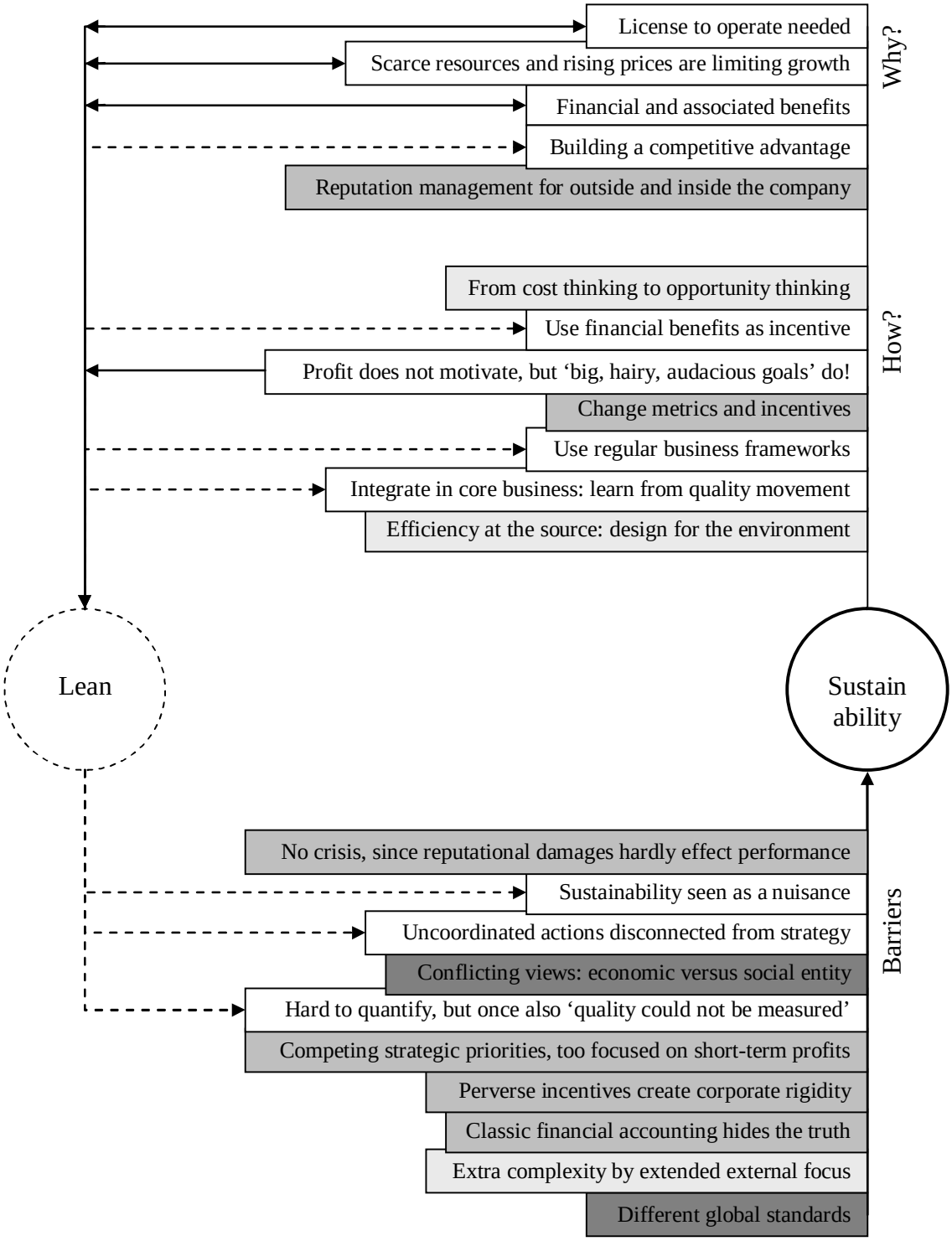


Figure 3.1: Conceptual framework with sustainability arguments

4 LITERATURE REVIEW – LEAN AND SUSTAINABILITY

4.1 What are the commonalities (or gaps)?

Since the mid-1990s several researchers and environmental experts have identified a strong compatibility between lean and environmental improvement, based largely on case examples (Larson and Greenwood 2004). However, Rothenberg *et al.* (2001) point out that theories suggesting a simple 'win-win' do not accurately reflect the complex relationship between manufacturing management and environmental performance.

4.1.1 Similar view, different criteria

Lean and sustainability are quite similar as they require more leadership than financial investment, and only work when management 'walks the talk'. Both are a journey rather than discrete projects, although with different decision-making criteria (Langenwalter 2006; SME 2008). Because rather than focusing on the economic side, sustainability focuses on three bottom lines: people, planet, and profitability. Yet, the first thing that comes to mind when linking lean and sustainability, is their drive for eliminating waste.

4.1.2 Eliminating waste serves both business and environment

That the focus on waste minimisation and continuous improvement is corresponding with environmental efficiency (Rothenberg *et al.* 2001) is also confirmed by a further examination of the EPA-OPEI (Larson and Greenwood 2004). But these efforts to achieve efficiency, Koechlin and Müller (1992) argue, are standard management science purely based on financial grounds! Only the parameters of efficiency are subject to change, for example due to higher resource prices or tax. Then the managerial concept of efficiency becomes increasingly an ecological one, then called 'eco-efficiency'.

Opportunities for improving efficiency are everywhere, and all represent avoidable cost, hence potential profits (Lovins *et al.* 1999). Therefore the business-case to pursue environmental management should not be hard to sell as the strongest internal incentive is often a financial one (Adachi 1992). Most environmental management systems (EMS) emphasise, just like lean, formal monitoring and improvement of waste streams, which often include opportunities for collaborative problem solving and continuous improvement. Or, like Gordon (2001) puts it: What's good for the business, less waste

and fewer production steps, is good for the environment too. King and Lenox (2001 p.245) even found empirical support for the assertion that "lean is green". But, Koechlin and Müller (1992) warn, the elimination of harmful substances can mean additional cost, thus dropping profit margins.

The link between lean's seven deadly wastes and environmental waste

Although environmental wastes (e.g. hazardous materials) are not explicitly part of lean's seven wastes, that does not mean that they are unrelated to the environment. In fact, large environmental gains can be made by implementing lean, because environmental wastes are related to lean's seven deadly wastes as shown below [Table 4.1] (EPA 2006). The word 'deadly' is actually even more applicable then.

Table 4.1: Environmental impacts of deadly wastes (adapted from EPA 2006 p.13)

Waste Type	*Environmental Impacts*
Overproduction	• More raw materials and energy consumed in making unnecessary products • Extra materials used result in extra emissions, waste disposal, worker exposure etc.
Inventory	• More packaging to store work-in-process (WIP) • Waste from deterioration or damage to stored WIP • More energy used to heat, cool, and light inventory space
Transportation and Motion	• More energy use and emissions from transport • More space required for WIP movement, increases lighting, heating, and cooling • More packaging required to protect components during movement • Damage and spills during transport
Defects	• Raw materials and energy consumed in making defective products • Defective components require recycling or disposal • Space required for rework/repair, increases energy use again for lighting, heating etc.
Over processing	• More parts and raw materials consumed per unit of production • Unnecessary processing increases wastes, energy use, and emissions
Waiting	• Potential material spoilage or component damage causing waste • Wasted energy from heating, cooling, and lighting during production downtime

4.1.3 Direct link between quality and eco-efficiency

Building in-station quality rather than end-of-the-line inspection, has a similar logic to reducing pollution in the process rather than treating it at the end-of-the-pipe (King and Lenox 2001). Therefore, the case of eco-efficiency is quite similar to that of Total Quality Management (TQM) as resources are treated with greater care, resulting in fewer rejects and lower material usage. This makes the concept of quality increasingly important to eco-efficiency, because there is a direct link (Koechlin and Müller 1992).

4.2 Are there any conflicts between lean & sustainability?

4.2.1 Growth not sacrificed, even stimulated?

In direct contrast with environmental management is growth-oriented management, where growth should not be sacrificed, neither for environmental reasons. According to Adachi (1992), sacrificing growth is even against human evolution. Although, Porter and Kramer (2006) argue that the mutual dependence of corporations and society implies that both must follow the principle of shared value.

The issue of growth however, is not lean specific but a general management issue. Moreover, it might even conflict with the true lean philosophy to base management decisions on a long-term philosophy, even at the expense of short-term financial goals. On the other hand, Jim Womack (2003) argues that lean might increase consumption, due to lower product cost. But, lean also supports 'green'. Because it dramatically improves production and distribution concepts which make green products affordable.

4.2.2 Loyalty blocking information?

The famous loyalty of employees and other stakeholders in a lean enterprise supports thorough decision-making and quick action. But, Adachi (1992) argues, it can also limit the amount of information going in and out. Because a comfortable and uniform structure may discourage green ideas. However, this does not comply with the key lean principle of transparency. Adachi (1992 p.108) himself calls it "certain characteristics of Japanese systems", which are therefore not bound to lean itself.

4.2.3 Technology driven solutions?

A big contributing factor in the competitiveness of Japanese industries was, according to Adachi (1992), the large stake in technology. He points at the risk of solving problems by technology rather than at an earlier stage. Also because any environmental investment can be rendered useless by a technical innovation. However, he based this argument on Mr. Honda who "always tried to find a technological solution for a problem" (Adachi 1992 p.108).

Where it comes to the use of technology in a true lean organisation, rather the opposite is true. Because the keyword, in industry today, is flexibility. And to Toyota, flexibility

does not mean "pushing the latest technology onto operations and struggling to make it work" (Liker 2004 p.166). Since optimising production with technology is a classic case of improving one portion of the value stream, while ignoring the inefficiencies elsewhere. That's why a high-tech mass producer often loses from a flexible lean producer with continuous flow (Womack and Jones 1996).

4.2.4 JIT demands extra transport?

The just-in-time (JIT) delivery system is publicly criticised for its "egoistic nature" (Adachi 1992 p.109). To reduce congestion and urban air pollution, plants altered their JIT system (Rothenberg *et al.* 2001). But this can also be done with a lean approach. In the U.S. there used to be expensive milk-runs from supplier to supplier over great distances, with only partially full trucks. Lean supply management introduced cross-docking, so that trucks are now almost always full in either direction, bringing the amount and cost of transportation down considerably (Liker 2004).

4.2.5 Environmentally sensitive processes slow lean adoption?

Case studies at Boeing showed that it had significant difficulties applying lean strategies to environmentally sensitive processes. Because the complex technical and regulatory constraints were considered to adversely affect implementation in time, predictability, and/or overall cost. This often led Boeing to modify the proposed lean efforts, resulting in sub-optimal implementation or abandon it entirely (Larson and Greenwood 2004). However, this seems not that much a conflict between lean and sustainability themselves, but more an obstruction to change in general by regulatory constraints.

4.2.6 Sticking to long-term solutions, despite current issues

Abatement equipment, though expensive but less invasive to the production process, can be an attractive protective 'buffer' for future regulatory changes. But buffers are in direct conflict with the basic lean principles which aims to minimise them. Besides, organisations living up the lean philosophy will be more confident in their ability to achieve emissions reductions through process optimisation. They will even try to avoid abatement-technologies, for the more long-term goal of reaching (environmental) improvements through process improvements. As a result, lean organisations – despite

their efficiency achievements – can still fall behind, on the short-term, to those that use extensive control technology (Rothenberg *et al.* 2001).

Another example, provided by Rothenberg *et al.* (2001), is the lean aspect of superior quality. Lean plants may use more water, as water is critical to maintain high product quality. Besides, water reduction often implies a substantial change in the design of a particular process and the water flows in the plant.

4.2.7 Focus on high cost resources, not 'problematic' resources

Rothenberg *et al.* (2001) also argue that lower cost resources, such as water, are less attractive to focus on. This is true, because improvements are made where the greatest cost reductions can be achieved (Shingo 1981). This is why the EPA (2006) proposes to extend lean waste identification activities, using for example Value Stream Mapping (VSM), to consider pollution and toxic materials together with cost reductions.

4.3 How can lean support sustainability (and vice versa)?

4.3.1 Waste elimination culture

First, the lean approach can bring significant resource productivity improvements with considerable sustainability implications (Larson and Greenwood 2004). An important aspect here is buffer minimisation, as it requires continuous process improvements by focusing on the minimisation of waste (Rothenberg *et al.* 2001). Traditional business processes, in contrast, hide many inefficiencies without noticing, as people assume that a typical process takes that much time or material (Liker 2004). This culture of systemic, continuous improvement focused on waste elimination is precisely the type of culture that environmental agencies have sought, to encourage eco-efficiency initiatives. Larson and Greenwood (2004 p.35) therefore also state that this is "a very fertile corporate culture into which the seeds of eco-sustainability initiatives can be dropped."

Indeed, a culture that can continuously improve itself won't have trouble with environmental improvements. However, one that tries to implement lean but struggles with the 'continuous' cultural side, will inherently struggle with the continuous drive for eco-efficiency as well. Thus only a true lean organisation is a fertile ground, not any 'leaning' organisation!

High level of worker participation

The lean waste elimination culture derives from the higher level of worker participation (at all levels) and the greater ability to implement process change, because of a broader skill base. Much of the participation takes place through formal suggestion programs and quality circles. And the more 'hands-on' approach (walking the shop-floor) further accelerates this. This employee involvement has been identified as a driver of improvements in environmental efficiency as well. An environmental manager at one Japanese plant explained the role of workers in environmental management this way:

> The whole key to environmental performance is people.
>
> (Rothenberg *et al.* 2001 p.236)

Another important aspect is the freedom to experiment with process improvements, even at the risk of hampering production (Rothenberg *et al.* 2001; Langenwalter 2006). This freedom encourages people to think creatively about taking steps before waste is even created (Gordon 2001).

Investing in people and processes leads to desired results

Where results-oriented managers immediately want to measure the bottom-line results of the continuous improvement program, process-oriented lean managers are more patient. They believe that an investment in the people and the process eventually leads them to their desired results. They develop a system and keep improving it, instead of jumping from one fad to another (Liker 2004). This long-term commitment is an important cultural difference!

4.3.2 Whole system thinking: sticking to the longest value stream

Whole-system thinking, of which lean is an example, has helped many companies dramatically reduce several forms of waste. Applying this to the productivity of natural resources can achieve even more, by helping managers find small changes that lead to big savings. Because, a right investment in one part of the system can produce multiple benefits throughout the system (EPA 2000; Gordon 2001; Lovins *et al.* 1999). Womack and Jones (1996) note that the best results from a value stream analysis come from sticking to the longest stream.

4.3.3 Leverage lean initiatives to 'subsidise' eco-sustainability activities

Eco-sustainability initiatives often come through the 'green door' (i.e. EH&S staff) with too much emphasis on the green aspect, which then requires translation to senior management before it will be embraced and implemented (Larson and Greenwood 2004). Gordon's (2001) guideline for an environmental approach therefore, is to stress to management that the organisation will become more profitable. Advised is to start with strategies that yield the highest rewards to profit and planet.

Case studies show that lean can bring useful new financial incentives with better expectations of the potential cost and benefits, by significantly reducing, or even eliminating, the marginal cost of resource conservation and pollution prevention (King and Lenox 2001; Larson and Greenwood 2004). But remember, in a true lean organisation managers do not have to make a detailed cost-benefit analysis every time they want to implement something that will improve the flow (Liker 2004).

4.3.4 Sustainability an even more powerful motivator

The commitment to lean might be three times that to 'normal' change programs, towards sustainability it is even three times that of lean (SME 2008). Because, Langenwalter (2006) argues, sustainability taps much deeper into our human desire to care about the health of people and planet, which acts as a powerful motivator.

Therefore eco-sustainability should be incorporated into lean initiatives, by helping to address more completely and directly ecological risk and full material life-cycle considerations (Larson and Greenwood 2004). According to Liker (2004), Toyota is the real-life example of being profitable while doing the right thing, even if it meant to sacrifice short-term profits.

4.3.5 Create value, beyond QCD, with environmental improvements

Figure 4.1, on the next page, highlights the relationship between cost and perceived customer value. Value can be increased when cost are reduced, or by additional services valued by the customer, such as shorter delivery times or smaller delivery batches, which do not add additional cost in a true lean system.

However, customers often value a wider range of tangible and intangible attributes such as brand, image, and environmental issues (Hines *et al.* 2004). This is where sustainability can contribute joint customer value.

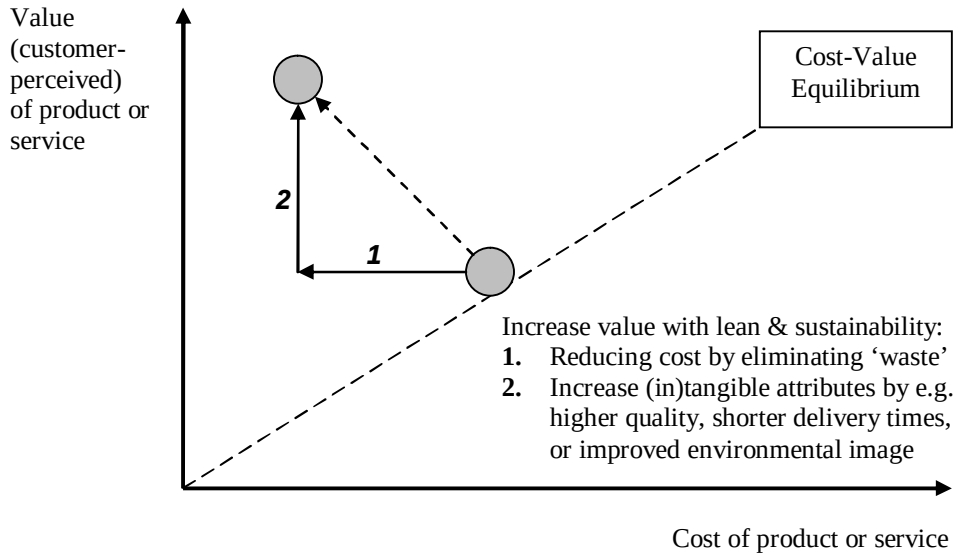


Figure 4.1: Relation between value, cost and waste (adapted from Hines *et al.* 2004 p.997)

4.3.6 Extend lean tools and techniques towards sustainability approach

For a company already on its lean journey, picking up sustainability should be relatively easy. Teams focusing on sustainability can incorporate traditional analytical lean tools into their analyses (Langenwalter 2006; EPA 2000). The EPA (2006) offers a *Lean and Environment Toolkit* with practical strategies and techniques to improve lean results while achieving environmental performance goals. They start by giving environmental examples of extending the seven 'deadly' wastes [Table 4.1 page 30], Value Stream Mapping, *kaizen*, and 5S.

Track sustainability issues with VSM and extend lean's analysis

Value Stream Mapping (VSM) is widely used in lean thinking to see 'the whole picture', making it easier to decide where to focus improvement efforts. Extending it to sustainability can be done just by adding some appropriate metrics (Langenwalter 2006). Then, for example, hazardous materials can be analysed as if they are process defects. This would also extend lean's analysis in a place where it appears weak, while additional cost would only be marginal (Larson and Greenwood 2004).

When planning future lean improvements, early attention to sustainability issues can help companies to address potential regulatory compliance issues. This is why the EPA (2006) suggests to involve EH&S staff as early as possible.

Be aware of kaizen impacts on EH&S

Adachi (1992) notices that ***kaizen*** events, and worker involvement in continuous quality improvement activities, can be equally applicable in environmental management. But he warns that ***kaizen*** events can result in regulatory compliance violations and/or cause health and safety hazards for workers if they are not properly managed. The EPA (2006) suggests, therefore, training lean team leaders to recognise EH&S impacts.

Increase safety using 5S

In TPS 5S (the five pillars of the visual workplace) is a method to create and maintain a clean, orderly, and safe work environment. It is often the first method companies implement in their lean journey, since it serves as the foundation of future continual improvements. Some organisations add a sixth S for safety. Also the EPA (2006), where the safety pillar is described as respect for the workplace and employee to create a safe place to work. But safety in itself is a result (Langenwalter 2006).

Find root cause of problems with 5 Why's

Asking five times 'Why?' is used to find the root cause of underlying (organisational) problems, so that a whole range of similar problems can be prevented from occurring again (Liker 2004). The example below shows the power of it.

Table 4.2: The power of the five times 'Why?' (adapted from Liker 2004 p.253)

Level of problem	*Corresponding level of countermeasure*
There is a puddle of oil on the shop floor	Clean up the oil
1. Because the machine is leaking oil	Fix the machine
2. Because the gasket has deteriorated	Replace the gasket
3. Because we bought gaskets made of inferior material	Change gasket specifications
4. Because we got a good deal (price) on those gaskets	Change purchasing policies
5. Because the purchasing agent gets evaluated on short-term cost savings	Change the evaluation policy for the purchasing agents

4.4 Concluding combined arguments in conceptual framework

The supporting arguments, communalities, differences, and conflicts, are summed and depicted in the conceptual framework below. The legend can be found on page 14.

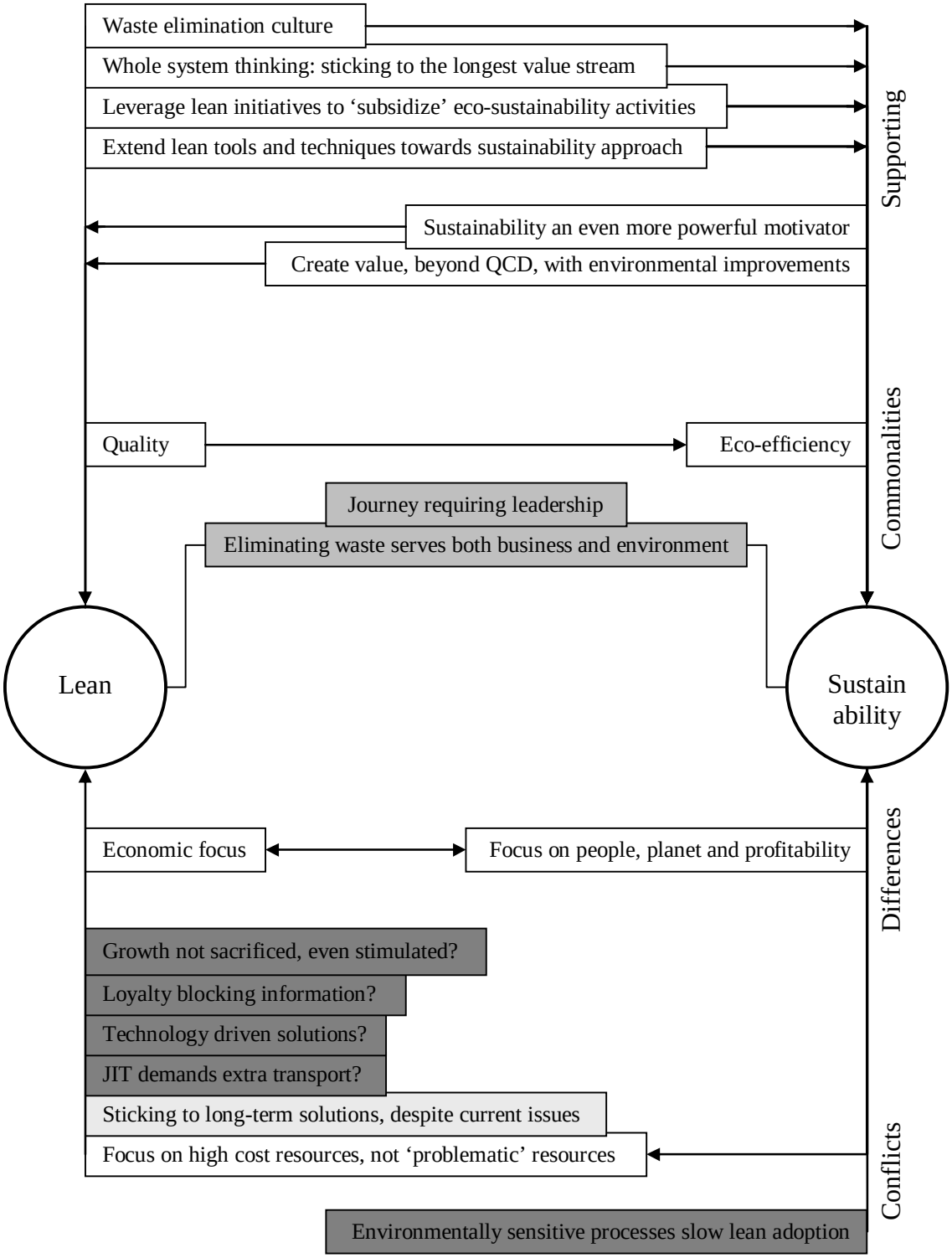


Figure 4.2: Conceptual framework with lean and sustainability arguments

5 METHODOLOGY

5.1 Objective: mutual benefits

The general objective of this project is to establish a set of recommendations which can help managers concerned with lean and/or sustainability implementations. The project will attempt to show how sustainability can provide 'positive' incentives for applying lean. At the same time it will attempt to show how to make sustainable development economically more attractive by applying lean principles. As a result lean may become more attractive as part of a 'green solution'.

5.2 Scope: original lean philosophy

This project ultimately tries to understand how both worlds (lean & sustainability) can support each other, and to give them (strategic or tactical) reasons to cooperate. It does not provide (operational) tools. Besides this, it clearly focuses on the original lean philosophy and not on related improvement programs such as Six Sigma. It also tends to focus on the economic and environmental benefits, and less on the social element of sustainability. The focus within the cases is on the situation in the Netherlands.

5.3 Breadth: both deductive and inductive, and exploratory

The breadth of the research concerns the research approach. Saunders *et al.* (2007) argue that in practice research is likely to combine elements of both the deductive and inductive approach. This is also true for this report, starting with a literature review to establish a current state of knowledge (deductive); then test its applicability through subsequent data collection and analysis (inductive). The main research design is as such an exploratory study (Saunders *et al.* 2007).

5.4 Depth: comparative case study, and qualitative

A comparative case study approach is used as it is suitable for an exploratory research, because it has the ability to get answers to the questions 'Why?' as well as 'How?' and 'What?' (Saunders *et al.* 2007).

This project follows the description of Dul and Hak (2008 p.4) where "a case study is a study in which one case (single case study) or a small number of cases (comparative case study) in their real life context are selected, and where scores obtained from these cases are analysed in a qualitative manner." Because it is time constrained the research is cross-sectional (Saunders *et al.* 2007).

A limitation to this case study approach, and using semi-structured interviews, is that the results will not be generalisable (Saunders *et al.* 2007). However, this is not its purpose as it only tends to explain what is going on in some particular cases, on which further research can be based.

5.5 Case selection: internationals using lean & sustainability

The cases were selected on the basis that they: have adopted a lean management approach; also adopted a sustainability stance; are a large international company, because of its impact on people and planet; are publicly trading, to have access to some secondary data (e.g. CSR reporting) through their website; and are accessible, located in the West of the Netherlands.

The first case has 42,000 employees worldwide, of whom 11,000 in the Netherlands. The second case has 92,000 employees worldwide, of whom 28,000 in the Netherlands. The third case has 63,000 employees worldwide, of whom only 900 in the Netherlands.

5.6 Roles and responsibilities: implementation managers

The people to interview, per case, are a Lean Change Agent and an Environmental, Health & Safety (EH&S) Manager, or people with similar responsibilities. As the choices made and the questions why are important, the interviewees must be responsible for the strategic level of the implementation, thus not the operational part which is usually done by others.

5.7 Data collection: semi-structured interviews

5.7.1 Using interview themes related to literature review

Semi-structured interviews are developed using interview themes related to the categorical issues found in the literature review. These were then extended with probing questions to obtain greater detail from the participants [see Appendix B]. The themes were sent to the interviewee for preparation and to build rapport (Saunders *et al.* 2007).

5.7.2 Using further preparation to build credibility

Each interview was scheduled for two hours, one and a half for the interview and another half for additional exchanges of information. Before the interviews took place the website and CSR reports were screened, which is important to be well informed about the organisational situation (Saunders *et al.* 2007). The interview themes together with a short confirmation of day, time and location were sent. This was done to enable the interviewee to prepare, and again to build credibility (Saunders *et al.* 2007).

5.7.3 The interviews

The first step was looking for the interviewee's organisation definition of lean/sustainability, to find out their stance and have a common understanding as a basis for the rest of the interview. The second step was finding the reasons for adopting lean/sustainability. Then asking how it was implemented and what the main barriers were. Finally, interviewees were asked whether and how lean and sustainability were or could be combined and if they knew any contradictions. A question that emerged from reading organisational documentation was: what their definition of waste is, as this seemed to differ.

During the interview notes were taken and summaries provided, again to built trust and enhance reliability. The final transcription was sent to the interviewee as an extra check point for the correctness of understanding.

6 RESULTS

6.1 Analysing qualitative data

6.1.1 Replaced one case to have enough data

To have at least three useful cases for 'enough' data, one case had to be replaced last minute (one interviewee changed jobs, and his successor did not have the time to invest in the interview). This case had to be dropped as both a Lean Change Agent and an Environmental, Health & Safety Manager had to be interviewed for one case. Building rapport with contacts and interviewees very early was found to be very useful here, as there was still time and other contacts available to approach.

6.1.2 Organised data into meaningful and related categories

Although there are many ways, there seems no standardised approach to the analysis of qualitative data. However, one common feature involves the organisation of the qualitative data into meaningful and related categories. This analysis is an ongoing process, of rearranging data and searching for patterns, hence offering a flexible route to analysis (Saunders *et al.* 2007).

6.1.3 Triangulated using secondary data

Other significant organisational documentation (secondary data, mainly website and reports) was used to try to triangulate the collected data. As such, key points were taken from the corporate responsibility reports of each case (Saunders *et al.* 2007).

6.1.4 Used template analysis

Part of the process is data reduction which includes summarising and simplifying the collected data and focusing on some parts of this data. This report uses a procedure known as "template analysis", which is essentially a list of categories that represent the themes revealed from the data (Saunders *et al.* 2007 pp.496-7). Again this is a combination of both the deductive and inductive approach, in a sense that the main categories were derived deductively by considering existing literature and theory before proceeding to collect and analyse data (Saunders *et al.* 2007). These main categories were then extended after analysing data.

6.2 Result of the findings

6.2.1 Communalities

Common goal for continuous improvements, although hard to sustain

The continuous strive for improvements is seen as the common element, although with some different focus. And for both, the difficulty lays within the continuity, constantly pursuing improvements and to sustain them. One said [free translation], that "an improvement is easily seen as an end result, instead as a step towards perfection."

People are the key, but middle-management is less involved

In all instances employees are seen as the key to both lean and sustainability. A workforce of over 50,000 people are many ambassadors, and as a collective can have a great influence. However, middle-management is often less involved somehow, which appeared to be a barrier as implementers are less supported in their efforts.

6.2.2 Differences

Lean's wide versus sustainability's narrow concept of waste

The concept (or definition) of waste is quite different to lean and sustainability. Lean takes a broad approach, where all non-value adding steps are seen as waste. While sustainability takes a narrow approach, where waste is anything that is disregarded, destined for disposal or an environmental risk. This same difference in approach towards waste also appeared once in an internet discussion.

6.2.3 Lean supporting sustainability

Lean mainly brings practical guidance, less philosophic

The cases show that lean is mainly used for its tools and techniques as a practical guidance (process part). Companies implement, however, their personal philosophy – towards lean or sustainability – of a continuous need to improve. Lean mainly provides a tangible touch to the more soft cultural approaches, and at the same time it does manage to change behaviour as required. Its practical approach and simplicity are the reasons to use lean and not some other method like Six Sigma.

Lean provides overview, but also financial benefits

The reason to adopt lean was, in two cases, driven by the view of an inspirational lean site when noticing the absence of hectic, as well as having a good overview of processes, compared to their own 'busy' situation. Lean was subsequently adopted by top management. The second driver is still an economic one with the lurking competition in mind. In one case a crisis (financial pressure) was the primary drive.

Lean motivates as it takes away the hectic

The move towards lean came in all cases from top management. It is implemented as a project or program, mainly led by a special team, meanwhile incorporating it into daily processes. People tend to like the improvements as it creates overview and less hectic. Their creativity is used to continuously look for further improvements, although sustaining them, the interviewees said, is the hard part.

Sustainability is a result of good business processes, and makes business sense

Sustainability is seen as the result of good business processes, where for example safety or quality are a main issue. It was said that it also makes good business sense, as better processes save resources, hence reduces cost.

6.2.4 Sustainability supporting lean

Sustainability provides a sense of urgency

The main driver for sustainability is climate change, although that, by itself, is not the main external pressure. Sustainability is pursued for the license to operate and hence for economic reasons as well. The sense of urgency emerges from the fact that energy and materials get more expensive (soaring oil prices) and nowadays even emissions cost money.

6.2.5 Barriers towards sustainability

Difficult long-term (investment) thinking

The main constraint for getting on with sustainability appeared to be limited financial resources to make the initial investments, even when the payback or IRR hurdle was lower than for 'normal' investments. This is the result, one said, of lacking investment freedom as budgets were fixed by headquarters.

6.2.6 Conflicts

Standardisation contrasting the freedom of creativity

Albeit lean motivates people as it provides clarity and utilises their creativity, the step of standardisation takes away their creative freedom at first and can toughen work. This is mentioned as a contrast between lean and sustainability. However, they said, employees' creativity is highly needed, but more for the continuous search for improvements and less for fire fighting.

6.3 Concluding findings in conceptual framework

The supporting arguments, communalities, differences, and conflicts, are summed and depicted in the conceptual framework below. The legend can be found on page 14.

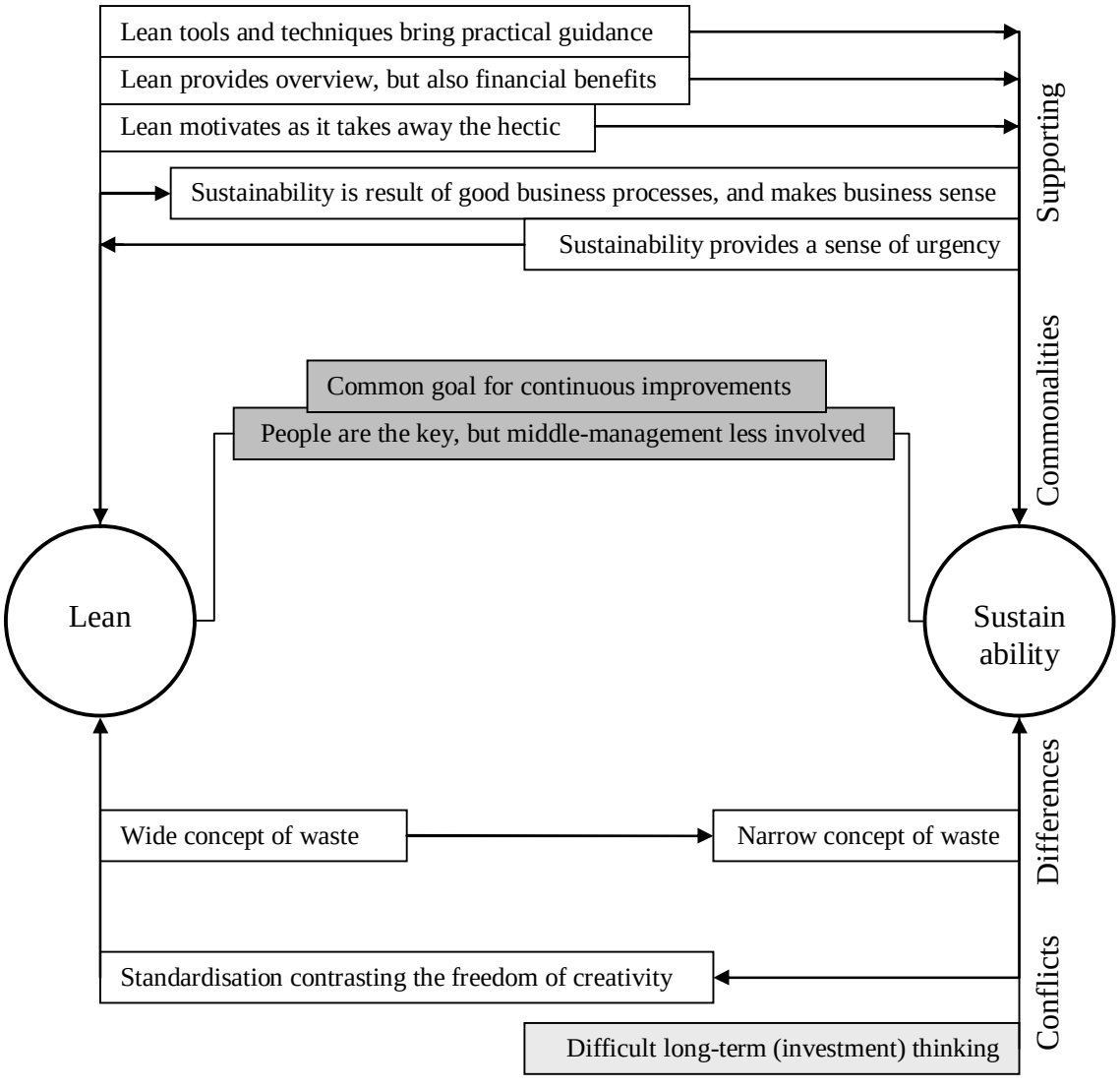


Figure 6.1: Conceptual framework of findings as result of interviews

7 DISCUSSIONS

7.1 Connection with overall research aim

7.1.1 Communalities, both positive and negative, reason for cooperation

Although there are many positive similarities, such as the drive to continuously improve and eliminate waste which make business sense, there are also issues in common that are restrictive to both. Like the difficult long-term investment thinking (too focused on cost cutting), the lack of involvement from middle-management, or perverse incentives.

These issues are, however, not unique to neither lean nor sustainability. They may well stem from a culture still contradictory to the long-term thinking needed for both approaches. It can be argued that the absence of such a 'fertile ground' will lead to the failure of a full implementation of either lean or sustainability. However, also these more negative communalities do provide good reason for cooperation because one can 'stand stronger together'.

7.1.2 Superficial adoption, when only using lean's practical guidance

As expected, lean provides practical guidance for continuous improvements, and as such it can help sustainability with a more tangible approach. However, the adoption often stays at process level. This is exactly what Jeffry Liker (2004) warns about: companies then fail at a true lean implementation, because they get stuck at the process part. That way, the whole stays superficial. Or better put by Shingeo Shingo:

> Many people believe that when implementing a new system, only know-*how* is required. However, if you want to succeed, you must understand know-*why* as well.
>
> (Shingo 1981 p.xxv)

7.1.3 Sustainability provides a sense of (financial) urgency

The emerging economic incentives of sustainability create a sense of urgency, and as a result more focus on environmental efficiency. As such, offering an extension to lean's applicability where it appears to be weak. Simultaneously, this makes sustainability easier to measure and because of that economically even more attractive.

However, the sustainability incentives are actually just financial (or legal) ones that impose a sense of urgency, and not that much the urge to leave the world a better place. Koechlin and Müller (1992), as already mentioned in the literature research, were totally right that the managerial concept of efficiency will increasingly become an ecological one due to higher resource prices.

7.2 Unexpected findings

7.2.1 Difference in concept of waste

Less expected is the difference between the concept of waste, where lean takes a wide approach while sustainability takes a quite narrow one. Especially so as it did not stand out in the literature. It is also not logical for sustainability to take such a narrow approach and therefore missing opportunities, as many aspects that can be considered waste are not included.

For example, as long as something is recyclable and does not end up in a landfill it is not considered waste. Thus, no matter how inefficiently it was produced and valuable resources already have been spent? There is a better approach available!

Similar to these contrasting views are those of 'Total Non-Product Output[1]' (wide) versus 'Total Waste[2]' (narrow) as discussed under the heading "pilot learning: waste is a tricky issue" in a report called *Measuring eco-efficiency: a guide to reporting company performance* (WBCSD 2000 p.19). Thus, discussions about this difference in concept of waste are still open, even on high level.

7.2.2 Standardisation makes work boring, at first

The expectation, however, was to hear examples of imposing regulations, making things more complex instead of more efficient. But, one issue that was mentioned constantly, was that lean's standardisation takes away creativity from employees which might lead to hollowing out a function. Therefore, EH&S knowledge should be welcomed at the

[1] Including anything that does not go into products (waste, air emissions and water emissions), because it leads to maximum eco-efficiency (WBCSD 2000 p.19).
[2] Total amount of substances or object destined for disposal in metric tons. Definitions of waste and disposal: Basel Convention 1992: Definitions and Annex IV (WBCSD 2000 p.21).

lean side to have another pair of eyes looking beyond the drive for efficiency, as recommended by the EPA (2006).

It must be noted, however, that all cases are still early in their adaption cycle (<5 years), and therefore may not have been able yet to fully implemented lean. As Womack and Jones (1996) only expect a sustained full adoption after at least five years.

7.3 Application of the findings

7.3.1 Use framework to crosscheck apparent strengths and weaknesses

The findings are especially interesting for managers that will lead, or are strongly involved, in implementing lean or sustainability practices throughout the organisation. The findings can be applied by crosschecking the potential weaknesses of the one (lean or sustainability) with the potential strengths of the other, as depicted throughout the frameworks. Communalities are also good reason for cooperation. As such, it offers suggestions on how to overcome barriers together that are withholding implementations.

7.3.2 Many other factors important to consider

It must be noted that there are many other important factors to consider. The factors depicted are the ones that can be supported by either lean thinking or a sustainability approach which were found in this research. It should be seen as an evolutional framework that can be extended. Especially because global and economic situations do change, and this is just a snapshot of the 2008 situation!

7.4 Recommendations

7.4.1 Bring lean and sustainability together

When both lean and sustainability are important for an organisation, the respective responsible managers should come together to link both efforts. Because it must be apparent by now that both can benefit from, and support, each other in some way or another. The frameworks can then be used as a common aid to guide their discussions and maybe even extend them with their own practical experiences.

7.4.2 Give special attention to the concept of waste

It is recommended that special attention is given to the concept of waste. A common understanding and a common approach would benefit especially the sustainability efforts towards eco-efficiency. And as a result it would offer lean other (environmental) elements to focus its efforts on, hence extending its applicability.

7.4.3 Adopt long-term philosophy, otherwise the rest stays superficial

As long as a company does not base its approaches on a long-term philosophy such as Toyota has, all the other actions may well stay superficial and will be hard to sustain, as depicted below. Because then, actions will not be connected to a core on which any management decision can be based on.

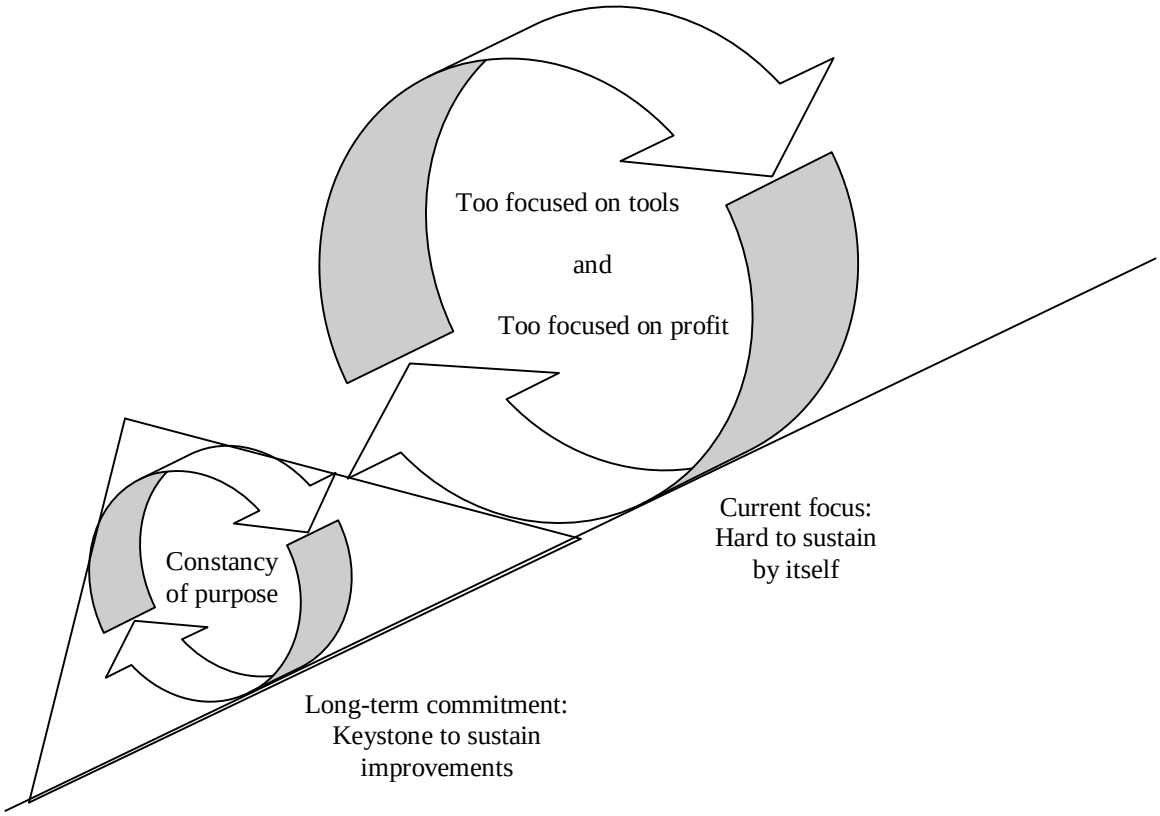


Figure 7.1: Taking up the Sisyphus[3] challenge

[3] Sisyphus was punished by Zeus to roll a huge rock up a steep hill, but before he could reach the top of the hill, the rock would always roll back down, forcing him to begin again (Wikipedia 2008).

8 CONCLUSIONS

8.1 Main aims and findings

The objective of this research was to identify how sustainability could act as a more 'positive' incentive for companies to adopt lean, and how lean could help to make sustainable development economically more attractive.

The findings show that lean is indeed applicable, mainly for its practical guidance by using its tools and techniques. As such. it can help to make the broad concept of sustainability more tangible. However, lean's long-term philosophic base is not that much adopted, therefore making its utilisation quite superficial and therefore more difficult to endure.

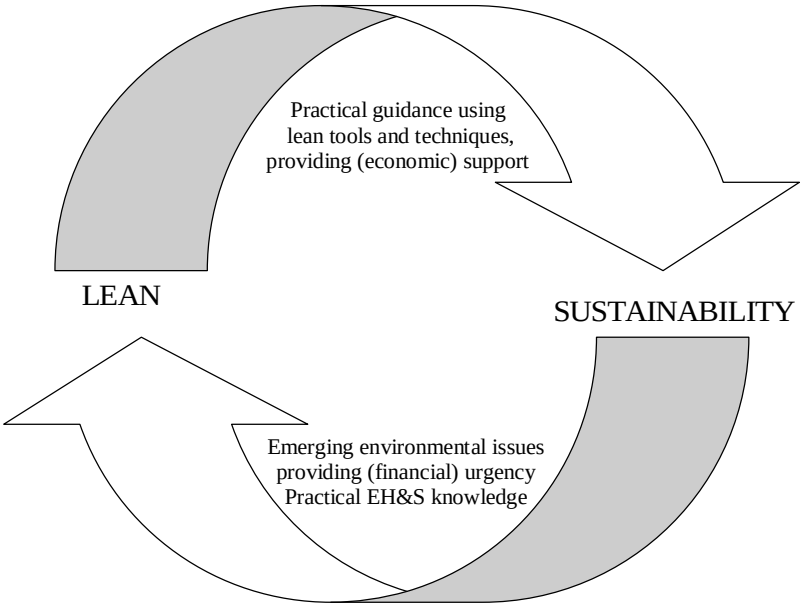


Figure 8.1: Lean and sustainability leveraging each other

Sustainability, in turn, hardly provides lean with incentives any other than extra financial arguments, which stem from rising resource prices and other economic incentives. Here too, practical support (EH&S knowledge) is useful and available for lean implementers. However, sustainability does not so much provide any deeper constancy of purpose such as 'preserving our planet'. Although, the emerging economic urgency may be creating a useful tide.

Despite this, there are plenty of reasons for both to seek each other's help. Maybe not always from a 'positive' perspective where one can clearly support the other. But just from the fact of standing stronger together facing mutual issues.

8.2 Limitations of the research

8.2.1 Cross sectional case studies not generalisable

A limitation to the case study approach, mainly based on interviews in a small number of organisations, is that the results will not be generalisable (Saunders, *et al*. 2007), although Dul and Hak (2008 p.47) dispute this. However, generalisability is not its purpose. It only tends to explain what is going on in some particular cases, on which further research can be based.

The research is only cross-sectional (Saunders *et al.* 2007), as it was time constrained. As such, all interviews were conducted within three weeks. The depth of the research is enhanced by the quite extensive literature review, in order to get a good overview of the current, but limited, coverage on the combined subjects. This was also a reason for taking a more pragmatic approach.

8.2.2 Different industries

The type of industry for each three cases is different. Another difference is that two cases have a large base in the Netherlands (around 10,000 employees or more), where one has a relative small presence (only around 1,000 employees). However, these differences highlighted that some findings were actually more related to the industrial environment and size. This might, otherwise, not have been so clear.

8.2.3 Early in their adoption cycle

It must also be noted that all three cases are still early in their adoption cycle (<5 years) and therefore not 'full grown' to a lean enterprise. Therefore there are still many lessons to be learned, and as a result this research may not always have found the full possibilities available 'out there'.

8.2.4 Interviews may have compromised objectivity

The approach to undertake semi-structured interviews may have compromised objectivity (Saunders *et al.* 2007). Although the interviewer asked primarily open questions and tried to refrain from non-verbal behaviour, it is still humans communicating and therefore interacting with some bias.

8.2.5 Implementation managers view

The fact that for this project only managers, directly responsible for implementing lean or sustainability, were interviewed, will restrict the results. The input for the interviews is only one-sided and can therefore be biased. Especially when it comes to questions about employee motivation, the answers are only based on, as one interviewee put it: 'gut feeling'.

8.2.6 Translations might have lost some essence

In retrospect the approach for a multiple case study was very time consuming. Especially as all interviews were conducted in Dutch, and as such the summaries were too, and had to be translated into English for the report. Although great attention has been paid, there is a chance of losing some essence of what was said, and how.

8.3 Future research on a broader scale

Because of the limitations of this research it is, therefore, proposed to expose the conclusions in other research settings in a follow-up study. This might be quantitative, more cases, and more focused on an industry. It is also recommended to extend the research beyond the implementation managers, towards other managers and even employees that undergo the changes. Then the social element of sustainability may also be more emphasised.

8.4 Practical applications of the findings

8.4.1 Difference in concepts of waste emphasises the need to cooperate

This research shows the overlap of both lean and sustainability, especially the drive for continuous improvement and eliminating waste. Although, the concept of waste is different, it consequently emphasises that both worlds should cooperate to leverage each other. Mainly managers responsible for, or strongly involved in, lean or sustainability implementations should take a wider view and approach, so much advocated in both lean and sustainability worlds!

8.4.2 Relevance and originality: emerging and more strategic

The relevance of this research lies in the fact that sustainability becomes rapidly important due to: accelerated resource usage and depletion, hence rising prices; the immense attention for environmental issues as a result of climate change; and the constant search for sustainable growth. It is original in the sense that this document does not focus on the extension of tools, but on the strategic incorporation of both worlds. A wide range of arguments was found for both, to take a broader approach and leverage one another.

The famous French aviator and writer Antoine De Saint-Exupéry wrote in his book *Terre des Hommes* (1939) an excellent conclusion for this project [translated]:

> Perfection is achieved, not when there is nothing more to add, but when there is nothing left to take away.
>
> (De Saint-Exupéry 1939 p.60)

APPENDIX A – MANAGEMENT PROJECT PROPOSAL

University of Bradford Number:	06024750
Project Title:	The Strategic Incentive of Sustainability (and CSR) for Lean Management
Supervisor:	Prof. Steve Brown
Company:	N/A
Planned Submission Date of the Report:	9 September 2008

1. Scope/Rational of Project

After reading Lean Thinking (Womack and Jones, 1996) I noticed that the reason for companies to apply lean management often came from a negative incentive like a (financial) crisis. (Although, there are companies adopting lean when they have a leader with a drive for perfection to become the best in their industry, under a 'World Class' or 'Operational Excellence' program).

Lean management is about creating value for customers and therefore attacking non-value adding actions (waste), therefore this has a communality with (environmental, social and economic) sustainability (EPA, 2003). News today (e.g. The Economist, 2007) shows that sustainability is a huge topic these days in business (e.g. as part of Corporate Social Responsibility) due to environmental changes. Therefore I wondered, how can sustainability (maybe as part of CSR) act as a positive incentive for adopting lean management? This topic seems still a greenfield.

The project will review current incentives for lean management. Then investigate whether sustainability would be an attractive option to introduce lean management to companies (as a 'green' incentive) and 'what it would take' to get companies to think this way. But also finding out if there are any conflicting sides! Recommendations will be made on the strategic approach to introduce lean with 'sustainability' arguments (or other, depending on the outcome of the research).

2. Method

The objective of the project is to identify how sustainability can act as a strategic incentive for companies to adopt lean management. This will involve identifying current incentives for adopting lean management, and check whether (and how) lean management can be an option for companies who want 'to go sustainable'.

The literature review will cover the latest developments on strategic incentives for lean management, and the role of sustainability in this. The possible role of CSR as a strategic incentive will be explored as well. Plus, whether there are any conflicting issues.

It is intended to carry out primary research by interviewing both Lean Change Agents and EHS (Environment, Health & Safety) Managers at three large international companies, which I contacted at the Dutch Lean Management Summit 2007. First to find out their reasons for adopting lean management, but especially their approach towards sustainability and how this relates to their lean management program. Resulting in recommendations on how to 'promote' lean management as a 'green solution' (maybe also for Governmental usage).

3. Data Sources

Primary information

- Interviews at large international companies (e.g. Heineken, Stork, KLM, Vita)

Secondary information

- Publications on Lean Management, e.g. Womack and Jones' books.
- Publications on Sustainability and CSR, e.g. Porter about Corporate Philanthropy.
- Publications on Strategic Incentives, e.g. Grant or Johnson, Scholes & Whittington.
- Publications on Lean and 'Green', e.g. Gordon.
- Current thinking on Lean and Sustainability, e.g. The Economist or HBR.
- Companies' information on CSR, Sustainability and Lean.

4. Aspects of MBA Syllabus Used

The project will involve aspects of the core courses in Operations Management, Strategic Management, and maybe the electives in Strategic Marketing, and Management of Change.

5. Proposed Chapter Headings and Sub-Headings(/Content)

1. **Introduction & Background**
    a. Why Lean & Sustainability?
    b. Objectives and expectations
    c. Companies' relation to Lean and corporate values towards Sustainability
    d. Report sections and key points

2. **Literature Review**
    a. Previous research on Lean & Sustainability
    b. Relevance of the subject and conclusions today
    c. Principal commentators and theorist on the subjects involved

3. **Methodology**
    a. Why qualitative research?
    b. Roles and responsibilities of people involved
    c. Analysing results and encountered problems

4. **Results**
    a. Result of the findings

b. Data collection issues
c. Comparing findings with other research

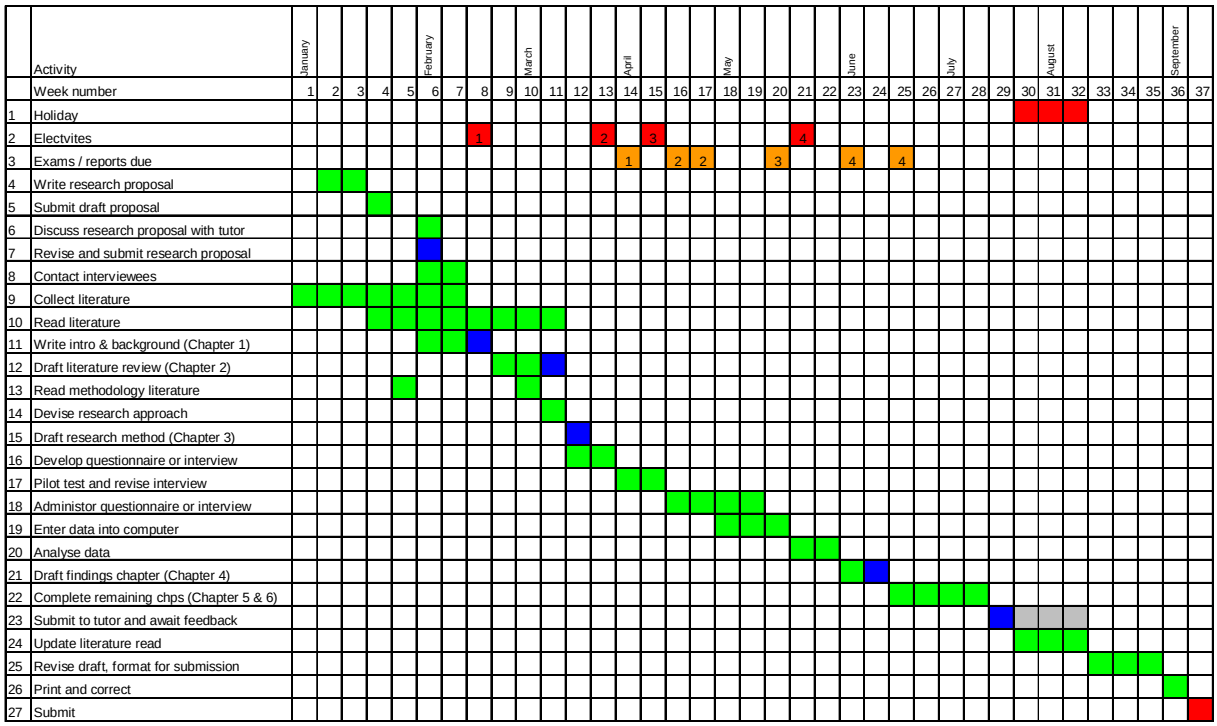
5. Discussions

a. Connecting findings with objectives
b. Meaning of the findings in theory and practice
c. Applying the findings
d. Recommendations

6. Conclusions

a. Main research objectives and findings
b. Practical applications to others
c. Unexpected problems and research limitations
d. Further research
e. Final sentence…

6. Work Programme



7. References (only for Proposal!)

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APPENDIX B – INTERVIEW THEMES

Themes and probing questions semi-structured interviews

What – Definition

How would you describe ‘lean/sustainability’?

What principles do you follow?

What do you mean by ‘waste’?

Why – Strategic Choices

Why do you use lean/sustainability?

Why in particular lean?

What are the main targets? (KPI’s)

How – Implementation and Organisation

How is it integrated within the strategy?

Where does sponsor/commitment come from?

Who are involved?

What does motivate the employees?

Barriers – Problem with implementation

What was the main barrier? Why?

How was this overcome?

What would ease the implementation?

Lean/Sustainability – Working with other programs

Do you work aside with the lean/sustainability programme? Why?

Who initiated it?

Do you see any contradictions between lean and sustainability?

Other – Extra information

Other useful info available?

Interesting additions?

Agreements?

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