Public institutions, companies and governments in the EU and around the world are increasingly engaging in sustainable public procurement – a broad concept that must consider the three pillars of economic equality, social welfare and public health and environmental responsibility when designing public tenders and finalizing government contracts.

This book contributes to the development of life-cycle criteria tools and methodologies for public procurement in the EU. It collects both sector-crossing contributions analysing the most relevant theoretical and legal aspects, including both EU law and contract theory, and sector-specific contributions relating to some of the most important sustainable goods and services markets. The book starts with a chapter that discusses the different approaches to including sustainability considerations in buying decisions by both private and public purchasers, and then goes on to examine the EU law on LCC and how it is implemented in different Member States. These chapters address the challenges in balancing economic and sustainability objectives under EU internal market law. One chapter develops the analysis with specific reference to public-private partnership. Another chapter elaborates how multi-stakeholders’ cooperation is necessary to develop LCC, based on a case study of a lighting services procurement. Three sector-specific studies relating to social housing, textile and clothing and IT close the book.

With contributors from a range of backgrounds including law, business, management, engineering and policy development, this interdisciplinary book provides the first comprehensive study on LCC within the framework of EU public procurement law.

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Abbreviations

CJEU Court of Justice of the European Union
Commission European Commission
EU European Union
GPP Green Public Procurement
LCC Life-Cycle Costing
MS Member States
SMEs Small and Medium Enterprises
SPP Sustainable Public Procurement
Foreword

Editors’ note

The topic for this book emerged from the conference ‘Procurement Beyond the Price’ organized by Dr Marta Andhov at the Faculty of Law, University of Copenhagen in May 2017. The idea was further fine tuned during a research stay at Prof. Robero Caranta’s home institution (University of Torino), where a series of intellectually stimulating conversations on Sustainable Public Procurement (SPP) and specifically issues of Life-Cycle Costing (LCC) led to the crystallization of the book. With the help of CEVIA and SMART Project, a research workshop on ‘Developing Life Cycle Analysis: Life Cycle Criteria tools and methodologies for public procurement in the EU’ was held at the Oslo University on 23 April 2018, where the editorial team was expanded with the addition of Dr Anja Wiesbrock. All of the contributions to this book are based on papers presented at the workshop in Oslo, where all participants benefitted from feedback and input to their draft chapter from fellow colleagues.

This interdisciplinary book brings all the debates and hard work together, with the underlying aim of contributing to the development of life-cycle criteria tools and methodologies for public procurement in the EU.

The scene

Public institutions, companies and governments in the EU and around the world are increasingly engaging in SPP – a broad concept that must consider the three pillars of economic equality, social welfare and public health and environmental responsibility when designing public tenders and finalizing government contracts. The purchase price only reflects a narrow range of product information. Prices fail to incorporate indirect supply chain costs (environmental and social externalities) and benefits (positive eco-system services). To go beyond price, complex methodologies are necessary to take into account a broader range of costs and benefits related to product production, acquisition and use.

1 Centre for Enterprise Liability, Faculty of Law, University of Copenhagen. This book contributes to CEVIA's research project on Private Governance.
2 European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 693642, project SMART (Sustainable Market Actors for Responsible Trade).
LCC is designed to fill this gap by evaluating the costs and benefits of a product throughout its entire life cycle, though methodologies remain in their infancy. LCC builds on existing life-cycle valuation tools that assess environmental impacts associated with all the stages of a product’s life from ‘cradle-to-grave’, by translating these impacts into a single metric – monetary cost.

One of the major novelties in the 2014 EU public procurement directives was the introduction of an LCC approach in the evaluation of the most economically advantageous tender. This cost-effectiveness approach implies that in the evaluation of the price-quality ratio of the goods and services tendered, all the costs associated to the life cycle of the production and the distribution of the products, including long-term costs borne by the contracting authority and costs imputed to environmental externalities, can be taken into account. The application of this approach, however, raises several questions and faces a variety of practical challenges. To avoid distortions of competition, life-cycle considerations must be based on non-discriminatory criteria that can be effectively and objectively verified. When contracting authorities assess the costs using an LCC approach, they shall indicate in the procurement documents the data to be provided by the tenderers and the method, which the contracting authority will use to determine the LCC on the basis of these data. The method must comply with a number of conditions, including being based on objectively verifiable and non-discriminatory criteria.

Developing LCC methodologies is effort-intensive, because such methodologies must be tailored on a specific product/service group or category. Challenges include long supply chains spanning the four continents and the difficulty in assessing – not to say measuring – non-monetary values like the respect for human dignity or the protection of biodiversity. Developing such methodologies rests on public institutions, including the Commission and contracting authorities, possibly through associations and networks to scale up the costs and efforts involved in the exercise. Certifiers, including ISO, also have a role to play.

The development of LCC methodologies requires cooperation between specialists from many sectors (supply chains and logistics, engineering, information technology, public administration etc.) and legal professionals. Whilst the former may tell us what is doable in practice, and how it can be done, the latter must ensure that all legal requirements are met. Building on these needs, this book is intended as the start of an interdisciplinary dialogue between authors having different backgrounds in engineering, policy development, management and other business sciences, with a number of legal scholars tasked with clarifying the new EU rules concerning LCC. Given that LCC methodologies must be tailored to very diverse products and service categories, more interdisciplinary work involving contributions from even more specific fields will be needed in the future.

**Book structure and outline**

The book collects both sector-crossing contributions analysing the most relevant theoretical and legal aspects, including both the EU law and contract theory (Part 1), and sector-specific contributions relating to some of the most
important sustainable goods and services markets (Part 2). The latter chapters show how LCC is used today in practice and might be further developed in specific sectors and beyond.

The book opens with an introductory chapter on terminology and different approaches to including sustainability considerations in buying decisions by both private and public purchasers (Chapter 1). Czarnezki and Van Garsse answer the question of ‘What is life-cycle costing?’ by first describing the narrative of life-cycle assessments on which LCC is based. This chapter then defines LLC and discusses related and similar terms such as impact valuation, true cost of ownership and true cost accounting to provide a standardized terminology throughout the other chapters in this volume.

In Chapter 2, the editors proceed to examine the EU law on LCC. To safeguard unhindered competition on the internal market, the EU law provides more and more detailed guidelines for contracting authorities wishing to buy in sustainable ways. The 2014 reform was fundamental in this respect. Generally speaking, the lawmakers made the legal framework for SPP much clearer. The new rules on LCC, however, demand much effort to become operational and pitfalls need to be mapped and properly understood.

In Chapter 3, Carvalho provides a comparative analysis of selected Member States’ experiences in developing and applying LCC methodologies. The chapter includes not just good practices but highlights lingering issues as to the way EU law is drafted and interpreted across Europe. While the experience in the application of the 2014 Directives is per force limited, the Member States have been implementing the Directive 2009/33/EC (now repealed), on the promotion of clean and energy-efficient road transport vehicles for years. This directive makes LCC semi-mandatory when buying vehicles. Moreover, some Member States had already been experimenting with LCC.

Chapter 4 develops the analysis with specific reference to public-private partnership contracts (PPPs). PPPs bring improved operational efficiency and, perhaps most importantly, a long-term life-cycle perspective on the facility maintenance. Government carries out an ex ante assessment to identify whether the PPP project is likely to achieve ‘value for money’. Van Garsse points out that life-cycle analysis (LCA) is a core component of the value for money assessments and assists public managers in their decision-making process. This chapter presents the main methodologies tried and tested in PPPs in Europe: it addresses their challenges and identifies the lessons that may be learned for other types of procurement.

As a bridge between these more general chapters and those which are sector specific, Chapter 5 elaborates how multi-stakeholders’ cooperation is necessary to develop LCC based on a case study of a lighting services procurement. Lozano and others propose to move from an approach engaging solely supplier and procurer in SPP to the application of a collaborative approach. The proposal is empirically grounded on a function procurement project (of lightening) in Bollnäs, Sweden, focusing foremost on economic sustainability.

Further follow sector-specific studies relating to Information and Communication Technologies (ICT) (Chapter 6), Textile and Clothing (Chapter 7) and
Foreword

Construction – Social Housing (Chapter 8). These studies focus on real-life LCC – and labels – experiences, their shortcomings and the lessons, which might be drawn from them.

In Chapter 6, Suciu and Dragoș focus on identifying good practice models for LCC in public and private ICT procurement, in order to aggregate the basic components of an LCC approach that can be applied in public sector procurement. The authors apply a qualitative research methodology based on extensive interviews, as an instrument for gathering insights from the ICT sector companies and from the procurement experts in Romania. The chapter showcases the practical challenges associated with LCC.

In Chapter 7, Koszewska assess the role of eco-labels for textile and clothing products in GPP and identifies the main trends and challenges for the future, including the development of sector-specific LCC methodologies. The chapter analyses the scope and market size of textile and clothing products in public procurement, discusses the current and possible future use of eco-labels and GPP criteria for textile products in the SPP as well as the importance of Product Environmental Footprint (PEF) and the Organization Environmental Footprint (OEF) for public procurement.

Chapter 8 maps the development of an LCC framework for contracting authorities when procuring Social Housing in the EU. By employing qualitative modes of enquiry, the research comprehensively maps the legal framework and the literature specific to LCC for construction procurement, its development since the 1970s, the methodologies and standard measurements that have been advanced, the importance of the procurement route and the advantages and barriers to its use. Halloran assesses LCC use in the Social Housing Sector in the EU, with a focus on Ireland and its development of a national methodology for LCA and its use in its national framework for rapid housing.

What we have learned and the way forward

The main lesson we have learned from the research flowing through this book is that LCC is neither impossible nor for the faint-hearted. Starting with the latter claim, a number of difficulties indeed arise when trying to develop and implement LCC methodologies.

Regarding terminology, as shown in Chapter 1, different words not always denoting discrete concepts abound in this area. While conducting research for this book, on several occasions the authors came across solutions which were presented as instances of LCC, but actually they were cases of LCA if not simple total cost of ownership (TCO). Different terminological preferences also exist among different disciplines and sciences. These many differences are not just relevant because they make interdisciplinary dialogue more urgent – and this book was thought as an answer to this need. They make collecting best practices and disseminating them to practitioners more difficult, hindering the uptake of LCC.

Problems in designing and developing LCC methodologies are even greater and more impactful. They are so relevant to have impacted the implementation
in the Member States of Directive 2009/33/EC (the Clean Vehicles Directive). These problems are systematically analysed in Chapter 3, including with reference to the directive just mentioned, and dealt upon in most of the chapters in this book, such as, for instance, in Chapter 8. Indeed, all chapters bear witnesses to these difficulties. As Chapter 1 indicates as a way of warning:

Calculating LCC is a complex task that requires making assumptions about future costs, and the cost of externalities. Assessing these costs inevitably includes an element of unpredictability (for example on maintenance costs, energy consumption, as well as the product’s actual lifespan, the need for replacing products or parts).

Still, as the many examples collected in Chapter 3 and the sector-specific analysis in Chapters 5 to 8 show, LCC is in one form or the other already happening and – as shown in Chapters 2 and 3 – the EU legal framework is enabling contracting authorities to pursue sustainability through the use of LCA and LCC methodologies.

Seen from the view point of EU law, a main advantage of Article 68 of Public Sector Directive lays in its plasticity. All aspects in the life cycle of the good or service to be purchased, including externalities, may be included in LCC. But it is not necessary to include all of them. This plasticity allows regulators and buyers to pick and choose those aspects they think that are more important, but also to both embrace LCC to the extent it is already based on well-tested methodologies and to experiment. In regulating LCC, the EU law also lays down safeguards for fair competition in the internal market (and beyond). This is inevitable. It also brings medium or long-term benefits for sustainability. Requiring, as discussed in Chapter 2, ‘objectivity’ in the assessment of LCC benefits, EU law is consistent with the basic tenets of the scientific revolution started in earnest in the closing decades of the sixteenth century. Claims must be verifiable, including those pertaining to sustainability. ‘Objectivity’ will help in developing sound LCC methodologies and in discarding approaches which do not partake credible information. While the focus in this book is on public procurement, commercial buyers too benefit from methodologies capable of calculating purchasing and operational costs. As recalled in Chapter 1, TCO, a predecessor to both LCA and LCC was taken up very early in the private sector. Sound LCC methodologies will allow commercial buyers to vindicate their sustainability claims, which are often today part of CSR policies.

Monetization as required in Article 68 of Public Sector Directive goes a step farther, opting for a specific way to account for benefits that may help contracting authorities in making their choices in a transparent way. Monetization is, however, the last step in taking into account the different aspects in the life cycle of the goods or services to be purchased. It requires full maturity in the capacity of assessing those aspects, and, as is often stressed in the different chapters of this book, developed science based on a huge load of verified data. While the process is ongoing, using LCA as clearly allowed under Article 67 of Public Sector Directive is without doubts the preferred option for SPP.
Foreword

The legal framework being both in place and supportive of both SPP in general and LCC and LCA in particular as explained in Chapter 2, the (further) uptake of both depends on policy actions. Seen from the point of view of EU policy, it is clear that the sustained uptake of LCC, and more generally of SPP, requires additional efforts on the part of the EU both in developing or contributing in developing LCC methodologies, and in promoting their use by contracting authorities in the Member States and by the EU institutions themselves when they are acting as buyers.

Concerning the development of LCC methodologies, both Chapters 4 and 5 clearly show that collaboration between the public and the private sector in all their articulations is both essential for and conductive to the creation of tools and practices in LCA and LCC. The difficulties in the enterprise having been already avowed, clearly more effort is needed in the development of LCC methodologies. The somewhat discouraging conclusions in Chapter 6 according to which the ‘Commission LCC tool for computers and monitors, made available at the end of 2018, seems minimalistic and unambitious when compared to the previous debates on the potential of LCC to change the practice of public procurement’ may be replicated in other areas as shown in Chapter 8.

Chapter 8 shows how labels may be used to make it easier for public buyers – and buyers more generally – to pursue sustainability. Lessons from long practice in the textile industries are particularly interesting, and their relevance for other industries deserves further investigation. This in turn calls for a holistic approach to LCC law making and interpretation, starting with a closer integration between the rules on labels on the one hand and those on LCA and LCC on the other hand.

Given the complexity inherent in LCC, and to a less extent in LCA as well, effective promotion of their adoption requires both supporting networks for the exchange of best practices and formation on the ground for contracting officials. In the end, it is upon the choices made by those officials that the future of SPP hinges.

Marta Andhov
Roberto Caranta
Anja Wiesbrock

3 Roberto Caranta, ‘Labels as Enablers of Sustainable Public Procurement’ in Beate Sjøfjell and Anja Wiesbrock (eds), Sustainable Public Procurement Under EU Law (Cambridge University Press 2016) 99.

Part I

Balancing economic and sustainability objectives under EU internal market law
1 What is life-cycle costing?

Jason J. Czarnezki and Steven Van Garsse

1.1 Introduction

Traditionally and not unexpectedly, when governments procure goods and services, the focus is on the lowest purchase price. The broader costs arising from production and distribution are often ignored, as are the future costs of use or disposal. For example, when tendering for a construction project for roads, environmental externalities or future cost of maintenance is in most cases not considered. However, those costs can be substantial, making the true costs of the good or service much higher than the initial purchase price. In other words, the initial cost is budgeted, but operating, maintenance, replacement, and disposal costs are not, nor are the costs borne by society at large and the natural environment.

An evolution in public procurement is underway. One of the major novelties in the EU public procurement law is the introduction of a life-cycle costing (LCC) approach in the evaluation of the most economically advantageous tender.¹ This novelty is not a coincidence but goes hand in hand with the rise of what is called sustainable public procurement – a broad concept that must consider the three pillars of economic (in)equality, social welfare and public health and environmental responsibility when initiating public tenders and finalizing government contacts.

Purchase price only reflects a narrow range of product information and final costs for consumers and society. Prices fail to incorporate indirect supply chain costs (environmental and social externalities) and benefits (positive eco-system services). To go beyond price, methodologies are necessary to take into account a broader range of costs and benefits related to product production, acquisition and use.² This brings us to the contemporary and ever-evolving concept LCC. Most simply, LCC can be seen as a tool that provides a structured approach that can assist in procuring entities in their selection and decision-making process when comparing projects for works, goods or services. LCC, in its fullest

¹ Public Sector Directive, recital 92 and art 68.
and purest form, attempts to measure and monetize the total cost of a product throughout its entire life cycle (extraction, production/manufacturing, packaging, distribution, use and disposal), though methodologies, scoping and terminology remain diffuse and in their infancy. In fact, many more or less related concepts exist such as life-cycle assessment (LCA), total cost of ownership (TCO), whole life cost (WLC), environmental LCC (E-LCC) and societal LCC (S-LCC), and even more methodologies are used to establish costs and benefits associated with those concepts. Most of these concepts face similar implementation challenges and pitfalls. Data challenges include the need for reliable real and historical data, needed data are not shared as parties see them as proprietary and commercially sensitive, necessary data are poorly documented, and inadequate understanding of how data can be analysed. Other difficulties include lack of agreement on and divergence of the methodological details, lack of common agreement on how to interpret some of the requirements of the methods used, lack of awareness of the benefits of the analysis, budget design and management, and rules on public expenditure often hinder the uptake of these concepts. It may therefore not come as a surprise that actors in the procurement process are slow and even reluctant in adopting LCC practices.

This short introductory chapter attempts to answer the question of ‘What is life-cycle costing?’ We will first describe the narrative of LCA on which modern LCC is partially based. This chapter then defines LCC and discusses related and more or less similar terms such as WLC, TCO, E-LCC and S-LCC, in an attempt to standardize terminology throughout the other chapters in this edited volume. This first chapter is therefore primarily descriptive, endeavouring to create a common ground for proceeding chapters.

1.2 Life-cycle assessment

LCA is a methodology that assesses, in narrative and descriptive form, environmental and social impacts associated with all the stages of a product’s life from ‘cradle to grave’. While both qualitative information and quantitative data are

3 Dacian C. Dragos and Bogdana Neamtu, ‘Sustainable Public Procurement in the EU: Experiences and Prospects’ in Francois Lichère and others (eds), Modernising Public Procurement: The New Directive (Djøf Publishing 2014) 324.


What is life-cycle costing?

Gathered, LCA does not attempt to quantify all externalities and monetise them as is the case with LCC, which is discussed later.

As shown later, LCA was developed in the 1960s as a method for quantifying the environmental impact of products whereby all environmental burdens connected with a product or service had to be assessed, from raw materials extracted to waste removal. LCA addresses a variety of environmental impact questions. Therefore, depending on the scope and the nature of the product or service, it can provide a whole range of results.

In its early days, as concerns were raised over the potential shortage of raw materials and energy resources, LCA gained much interest from American and European private companies in assessing the packaging of products and pursuing alternative sources of energy. According to some scholars, a 1969 internal study for The Coca-Cola Company laid the foundation for the current methods of life-cycle inventory analysis in the United States. In the study, different beverage containers were compared to determine which container had the lowest environmental impact. ‘The study quantified the raw materials and fuels used and the environmental loadings from the manufacturing processes for each container.’

During the oil crisis, LCA received attention as a solution to better manage energy resources, while in the late 1980s and the 1990s, LCA became a popular technique to analyse the environmental (e.g., toxic emissions, etc.) impact of products from cradle to grave. The strong involvement of the Society of Environmental Toxicology and Chemistry (SETAC), who organized many workshops and produced guidance in this period, comes as no surprise. The International Organization for Standardization (ISO) also became involved, as well as the United Nations Environment Programme (UNEP) who, together with SETAC, launched in 2002 an international life-cycle partnership focused on improving tools, data and indicators. All of this shaped the development of LCA over the years.

Now, LCA is a scientific, structured and comprehensive method that is internationally and to some extent standardized in ISO 14040 and 14044. For practitioners of LCA, ISO 14044 guidance details the requirements for con-

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7 Guinée and others (n 4).
9 Klöpffer (n 8); Hunt and Franklin (n 8).
10 ibid.
11 Guinée and others (n 4).
12 ibid; Horne (n 8).
13 In fact, LCA was never standardized in details and discussions remain on interpretation of some of the requirements. See Guinée and others (n 4).
ducting an LCA that addresses the environmental aspects and potential environmental impacts (e.g., use of resources and the environmental consequences of releases) throughout a product’s life cycle from raw material acquisition through production, use, end-of-life treatment, recycling and final disposal. There are three phases in an LCA study: (a) the goal and scope definition phase, (b) the inventory analysis phase and (c) the impact assessment phase, but there is no mention of costing. The International Reference Life Cycle Data System (ILCD) Handbook further specifies the broader provisions of the ISO 14040 and 14044 standards on environmental LCA.

LCA quantifies resources consumed and emissions as well as the environmental and health impacts and resource depletion issues that are associated with any specific goods or services, covering climate change, seasonal smog, toxicity, human cancer effects and material and energy resource depletion. Crucially, it allows for direct comparison of products, technologies and so on based on the quantitative functional performance of the analysed alternatives. LCA is increasingly being used in the marketing context, often through published environmental product declarations. (Note that in the public procurement context, economic entities will be the ones delivering this information to contracting authorities.)

LCA relies on five principles: (1) bringing a wide range of environmental problems into an integrated assessment framework, (2) capturing these problems in a scientific and quantitative manner, (3) allowing environmental pressures and impact potentials to be related to any defined system, such as a particular type of goods, a service, a company, a technology strategy, a country, etc., (4) integrating the resource use and emissions over the entire life cycle of the analysed system, from the extraction of natural resources through material processing, manufacturing, distribution and use, up to recycling/energy valorization and the disposal of any remaining waste and (5) facilitating comparisons of the environmental performance of different systems/options on an equal basis and helping to identify areas for improvement. Environmental LCA is ‘structurally open’ to growing into the full sustainability assessment that LCC seeks to become, where cost is integrated.
1.3 Life-cycle costing

Ironically, LCC predates LCA\(^2\); not in the scenario currently contemplated, but in a far simpler context. ‘Conventional’ LCC was considered a financial appraisal tool. In fact, LCC techniques are tools that evaluate the present and future costs of goods or projects throughout their life cycle. They enable a better assessment of the long-term implications of options under consideration and therefore a better decision-making. In order to compare several options, one of the key elements of performing an LCC analysis is discounting future costs to net present value.\(^2\) LCC analysis are, in other words, based on a forecast of the future. Thus, different cost estimation methods can be applied.

The decision to use LCC depends on the availability of data and the phase in which the calculations are done.\(^2\) Fabrycky and Blanchard described three different ways to estimate costs: (1) estimating by engineering procedures, (2) estimating by analogy and (3) parametric estimating methods.\(^2\) Also, more advanced methods of cost estimation have been suggested and used for LCC; for example, methods based on activity-based costing, a technique used by controllers to allocate (indirect) costs to products and services.\(^2\) Furthermore, the time-value of money needs to be accounted for in the calculations, implying that future cash flows should be discounted to present value.\(^2\) Therefore, a decision on a discount rate, and as some suggest even on an inflation rate, must also be made.\(^2\) Scholars furthermore acknowledge the stochastic nature of LCC calculations and suggest sensitivity analyses and the use a computerized mathematical technique (e.g., Monte Carlo Simulation) to deal with the uncertainty.\(^2\)

This conventional concept of LCC goes back to the US defence sector.\(^3\) In the middle of the last century, the acquisition of weapon systems was very much focused on performance and initial cost. This led to growing criticism. Focusing on acquisition price was, in fact, short-sighted. Technological evolution and the arms race between the United States and the Soviet Union led to many new weapon systems, but growing complexity caused an exponential rise in the costs


\(^{23}\) Higham and others (n 5).

\(^{24}\) ibid.


\(^{26}\) ibid.

\(^{27}\) ibid.

\(^{28}\) ibid.

\(^{29}\) ibid.

of maintenance and use. In some cases, it was even cheaper to buy new systems than to maintain older ones. These changes called for a more global approach leading to a better equilibrium between initial costs and costs of maintenance and use, as well as more transparency in the decision-making process. In response, LCC was introduced in the US defence sector. LCC was defined as the total cost to the government for acquiring, operating, supporting and disposing of a system over its lifetime. In the following decades, LCC gained growing importance in other market sectors (e.g., aviation) as well as the academic sector. This comes as no surprise considering the technical evolution where mainframe computers were replaced by more powerful micro and personal computers making LCC calculations more accessible and feasible. This technological revolution also gave rise to computer models used to analyse and simulate costs. LCC was often seen as a technique to establish the TCO (see also later), which certainly was from a historic perspective in its early stages. However, in its modern and current meaning, LCC has evolved and it includes quantification of product externalities. LCC, therefore, now demands both measurement and monetization. For example, Rebitzer and Hunkeler (2003) define LCC:

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\text{LCC has thus evolved from being a purely economic tool to a tool relevant for sustainability purposes. This is also clear from the new ISO 20400:2017, which provides guidance to organizations on integrating sustainability within procurement. Since sustainability is becoming more and more important, certain modern LCC tools include an environmental impact assessment. Indeed, LCC can include capture, measure, quantify and monetize environmental, social and health impacts of products and services (see later S-LCC and E-LCC).}
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31 ibid.
32 Twomey (n 30).
33 ibid.
34 ibid.
35 ibid.
37 ISO, Sustainable Procurement – Guidance (20400:2017 April 2017). LCC is defined as a ‘method for calculating the costs of goods or services throughout their life cycle’, while life cycle is described as ‘consecutive and interlinked stages of a goods or services system, from raw material acquisition or generation from natural resources to final disposal.’ ibid.
What is life-cycle costing?

As noted by the Commission in 2012, an integrated, authoritative approach for such an integrated life-cycle sustainability assessment still needs to be developed. This broader perspective on LCC was taken up in recent EU public procurement law and policy where LCC is a very important element in the effort to shift the paradigm of public procurement beyond the confinement of using solely the purchase price of a good or service. Under EU public procurement law, a contract must be awarded based on the most economically advantageous tender (MEAT). The most economically advantageous tender from the point of view of the contracting authority shall be identified on the basis of the price or cost, using a cost-effectiveness approach, such as LCC. As the Commission explains:

Life-cycle costing (LCC) means considering all the costs that will be incurred during the lifetime of the product, work or service: Purchase price and all associated costs (delivery, installation, insurance, etc.); Operating costs, including energy, fuel and water use, spares, and maintenance; End-of-life costs (such as decommissioning or disposal) or residual value (i.e. revenue from sale of product).

Article 68 of Public Sector Directive is devoted entirely to LCC. LCC can apply to both costs borne by the contracting authority and other users. Furthermore, Article 68 states that:

Costs imputed to environmental externalities linked to the product, service or works during its life cycle, provided their monetary value can be determined and verified; such costs may include the cost of emissions of greenhouse gases and of other pollutant emissions and other climate change mitigation cost.

The assessment of LCC must be based on objectively verifiable and non-discriminatory criteria and that when no established method exists, the applied method shall not unduly favour or disadvantage certain economic operators. The EU public procurement law requires that where LCC is used, the calculation method and the data to be provided by tenderers are set out

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41 Public Sector Directive art 67.
in the procurement documents. Specific rules also apply to the methods for assigning costs to environmental externalities, which aim to ensure that these methods are fair and transparent.\textsuperscript{44} The method used for the assessment of costs imputed to environmental externalities shall be: (a) based on objectively verifiable and non-discriminatory criteria and shall not unduly favour or disadvantage certain economic operators, (b) accessible to all interested parties and (c) the data required can be provided with reasonable effort by normally diligent economic operators, including economic operators from third countries party to the GPA or other international agreements by which the Union is bound.\textsuperscript{45}

Whenever a common method for the calculation of LCC is made mandatory by a legislative act of the EU, that common method shall be applied for the assessment of LCC.\textsuperscript{46} Currently, this only applies in relation to road transport vehicles under the Clean Vehicles Directive,\textsuperscript{47} which provides both a common methodology and minimum costs to be assigned to certain environmental externalities if these are monetized.\textsuperscript{48} Again, a movement towards LCC is important since purchase price alone does not reflect the financial and non-financial gains that are offered by environmentally preferable assets as they accumulate during their operations and use stages.\textsuperscript{49} Different approaches to LCC are used in a number of sectors.\textsuperscript{50}

LCC has recently proved to be feasible in the following markets: office and server IT equipment\textsuperscript{51}; vehicles, indoor and outdoor lighting\textsuperscript{52}; fuel and furniture; services such as electricity, transport, waste handling and catering beverages; construction of new buildings or refurbishment of existing buildings\textsuperscript{53}; railways and roads.\textsuperscript{54} Moderate applicability has been experienced for paper and food catering, couriers and postal services, as well as landscaping.\textsuperscript{55} Although no common methodology exists, over the years attempts have been made for

\textsuperscript{44} Commission, \textit{Buying Green! A Handbook on Environmental Procurement} (3rd ed, 2016).
\textsuperscript{45} Public Sector Directive, art 68(2).
\textsuperscript{46} ibid.
\textsuperscript{48} Commission, ‘Life-Cycle Costing’ (n 42).
\textsuperscript{49} Dragos and Neamtu (n 38).
\textsuperscript{52} See: Rodrigo Lozano and others, ‘Moving to a Quintuple Helix Approach in Sustainable Public Procurement: Collaboration and LCC for Lighting Procurements’ Chapter 5 of this book.
\textsuperscript{53} See: Deidre Halloran, ‘LCC within the Construction Sector: a Tool for Social Housing?’ Chapter 8 of this book.
\textsuperscript{54} Dragos and Neamtu (n 3) 332.
\textsuperscript{55} ibid.
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Creating more common, standardized approaches to calculating LCC in different fields. Noteworthy examples include the following:56:

- Commission’s calculator for LCC for vehicle procurement.57
- A tool for assessing both LCC and CO₂ emissions in procurement, developed within the SMART-SPP project.58
- An LCC tool developed within the BUY SMART project.59
- A common European methodology for LCC and a companion, guiding document in the construction sector.60
- The BS ISO 15686-5 (2008) standard for property LCC.

1.4 Whole life costing

The terms LCC and WLC are often used interchangeably.61 However, some literature does differentiate the two concepts. For example, LCC is sometimes described as a financial tool for early-stage product or project evaluation and initial investment appraisal.62 WLC is then described as a tool for management through its life cycle that also takes operational costs into account. A more or less similar approach can be found in BS ISO 15686-5:2008 where WLC is defined as follows: the ‘methodology for the systematic economic consideration of all WLCs and benefits over a period of analysis, as defined in the agreed scope’. Hence, WLC is considered to have a broader scope than LCC emphasizing not only economic life-span but also the entire span of real property existence including non-construction costs such as finance, business costs, incomes from sales/disposals, etc. and also external social/environmental costs and benefits (Figure 1.1).63

In WLC, all costs or expenses made by the organization are attributed to the systems or products they produce.64 WLC takes account of the total costs of making or purchasing and then owning (or even leasing), operating, maintaining and managing the requirement (including its end of life, including decommissioning, disposal or resale) over a specified period of time.

56 Commission, ‘Life-Cycle Costing’ (n 42).
62 ibid.
1.5 Total cost of ownership

TCO comes, as many of the other concepts, from the business sector. It received special attention in the 1980s and the 1990s as a purchasing tool. The focus is on the cost of a product in the value chain from a single business or user perspective. ‘The total cost of ownership examines the cost associated with purchased goods and services throughout the entire supply chain’. As opposed to conventional LCC, cost of development is not included. The focus is on the cost after the system or product is purchased. Determining the TCO has long been used by firms as a way to consider not just the acquisition costs when making purchasing decisions, but also the costs of operation, maintenance and disposal after acquisition by the user. The concept is also used by NATO. According to NATO research/documents, TCO represents all costs associated with the

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65 See Lisa M. Ellram and others, ‘Retail Logistics’ (1989) 19 International Journal of Physical Distribution Logistics Management 29; ‘[I]ndeed, the concept of Total Cost of Ownership (TCO) has been around in the business world for a while, and was really popularized by the Gartner Group in relation to Information Technology, where the approach has probably seen its greatest adoption (the Gartner Group started discussing this as far back as 1987)’. Martin Flusberg, ‘Don’t Pass (Up) the Buck: Understanding Total Cost of Ownership Leads to Long-Term Savings’(Powerhouse Dynamics, 3 December 2013) available at: <https://powerhousedynamics.com/blog/dont-pass-buck-understanding-total-cost-ownership-leads-long-term-savings/> accessed 21 January 2019.

66 Estevan and Schaefer (n 30).


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Ownership of a system except non-linked fixed costs that are related to the running of the organization. Non-linked costs are costs that cannot be readily associated with the system, unlike linked costs that can be associated with the acquisition, operation, support and disposal of the system. Variable costs are fluctuating costs that are affected by the existence of the system. An example of a variable cost is the cost of fuel. Fixed costs are costs that do not vary because of the existence of the system.

Internal costs, part of TCO, are typically assessed from the perspective of a single market actor. As a result, TCO does not consider external costs, and it excludes the use and end-of-life phases if the focal actor does not internalize these costs. This, in turn, likely excludes entire categories of environmental, social and health impacts and affected parties. Most TCO techniques were developed and ‘applied in the framework of decisions over products or investments requiring high initial capital, such as buildings, energy systems, transport systems, military equipment, and durable goods in general.’ TCO does not have an environmental focus unless those costs are somehow internalized; rather it focuses on economic viability or performance.

1.6 The need for inclusion of social and natural capital

Traditional economic valuation fails to extend beyond financial and asset capital, ignoring both natural and social capital, because of its narrowly defined perspective. Natural capital, also known as ecosystem services, refers to ‘the stock of renewable and non-renewable natural resources (for example: plants, animals, air, water, soils, and minerals) that combine to yield a flow of benefits to people.’ The exclusion of natural capital from basic economic decisions prevents firms from adequately addressing dependencies and associated risks, where externalities are actually indirectly internal. The definition of social capital varies, but generally refers to the resources and relationships provided by people and society. This encompasses human capital (people’s skills, knowledge and wellbeing), social capital (societies’ shared values, norms and institutions) and relationship capital (connections and network). Similarly, social capital must be included in LCC analyses, not just because doing so would include broader perspectives and

71 ibid.
72 Traverso (n 6).
73 ibid.
74 Fabio De Menna and others, Methodology for Evaluating Life Cycle Cost (LCC) (REFRESH, Commission April 2016). Guinée and others (n 4).
77 Martina La Valle, ‘Glossary Full-Cost Accounting’ (Food and Agriculture Organization of the United Nations April 2016) 59; See also Tristan Claridge, ‘Definitions of Social Capital’ (Social
additional interested actors, but also in order to ensure that dependencies and risks are considered.

When considering the interests of actors beyond the producer or user, such as those actors interested in or affected by the product and/or its life cycle, the inclusion of social and natural capital is necessary. Even from the perspective of a singular firm or user, there is a growing realization that both natural and social capital must be incorporated into decision-making for proper opportunity and risk analysis, and in order to consider impacts on humans and the environment that are of concern to that firm or user. An extension of this traditional economic valuation, therefore, requires a broader perspective, time span and assessment of costs not directly borne by the focal actor. This broader analysis can be understood in the context of the complementary LCA framework and broader LCC techniques (see later).79

1.7 Environmental LCC

An E-LCC methodology takes into account the main internal environmental cost categories plus external environmental costs, though not other societal costs. (Here, E-LCC can be likened to GPP, while S-LCC can be analogous to SPP as discussed later.) Relying on the LCA framework, E-LCC considers costs borne by one or more actors who are connected to the product’s life cycle, indirectly and directly, extending both upstream and downstream in the product’s lifespan occurring within the ‘decision relevant future’.80 These actors might be suppliers, manufacturers, users, consumers or end-of-life actors.81

To be introduced into an ‘accounting’ LCC process, environmental costs must be expressed in monetary terms. In other words, environmental costs would be quantified and monetized so they can be considered as an additional cost input in an E-LCC analysis. This is even more challenging when social costs are considered (see later). A case study of organic versus conventional extra-virgin olive oil illustrates the need for E-LCC and the need to account for external costs:

If one does not consider the external costs, the organic oil has a higher cost profile that is due to its lower agricultural yields. However, when external costs and less tangible, hidden, and indirect costs are included, this results in the organic oil having a lower total cost compared to the conventional oil.82

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81 Ibid pt 1.4.
82 Ibid 120.
E-LCC, however, is information intensive, requiring data on costs of the complex interaction between a product and the environment from cradle to grave. Data may not be readily available for analyses of products and systems, or for certain categories of externalities. ‘If all needed data are not available, then scenario development, forecasting, or other estimation methods may have to be employed.’

Environmental costs that might be considered in an LCC analysis for a food product or system include, but are not limited to, air pollution, biodiversity loss, climate change, deforestation, greenhouse gas emissions, land use, soil erosion, waste and water pollution. Some of these costs overlap with social and health costs, and vice versa.

1.8 Societal LCC

S-LCC is the term used when considering costs from a broader perspective including all social welfare, economic and environmental externalities. Generally, S-LCC, sometimes referred to as true cost accounting, assesses ‘all costs associated with the life cycle of a product that are covered by anyone in the society, whether today or in the long-term future’. The Lexicon of Sustainability defines true cost accounting as ‘a practice that accounts for all external costs – including environmental, social and economic – generated by the creation of a product’. It should be noted that environmental, social and economic dimensions comprise the three pillars of sustainable development as defined by the EU and other entities.

The consideration of all human and non-human impacts is consistent among these definitions of S-LCC. Figure 1.2 compares the scope of C-LCC, E-LCC and S-LCC.

Social and health costs that might be considered include, but are not limited to, animal welfare, antibiotic resistance, child labour, foodborne pathogens, healthcare costs, obesity, subsidies, taxes for welfare and social services and worker’s rights. These social and health costs span impacts from production to consumption.

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83 Dragos and Neamtu (n 4) 325.
84 Ciroth (n 69).
85 Savanna Henderson and others, ‘The Real Cost of Food: Examining the Social, Environmental and Health Impacts of Producing Food’ (True Cost Accounting Report, Food Tank 2015).
86 Other terms that may be used to describe this analysis include triple bottom line, true cost accounting, full cost accounting, natural capital accounting or cradle to grave.
89 ibid.
1.9 Conclusion

Sustainability is high on the International European agenda. For example, Target 12.7 of the Sustainable Development Goals focuses specifically on promoting ‘public procurement practices that are sustainable, in accordance with national policies and priorities’. To prevent shifting of burden focus is needed on the entire value chain; in other words, the WLC needs to be taken into account. It is, therefore, no surprise that LCC is gaining more and more attention in public procurement law, policy and practice.

The enormous economic importance of public procurement in the EU makes it an important driver for sustainability and the transformation of markets and also leverage to foster innovation and environmentally and socially sustainable growth. However, implementing life-cycle thinking is not a walk in the park. Public purchasers using LCC in a sustainability context will face many challenges. Calculating LCC is a complex task that requires making assumptions about future costs and the cost of externalities. Assessing these costs inevitably includes an element of unpredictability (e.g., on maintenance costs, energy consumption, as well as the product’s actual lifespan, the need for replacing products or parts).

This chapter provides insights into the concepts, main features and challenges of LCC. In the interest of academic consistency and clarity, scholars should note, as this chapter stresses, the difference between the TCO, LCA and LCC, and E-LCC, S-LCC and WLC, as seen in Figure 1.3.91

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91 Norwegian Agency for Public Management and eGovernment (Difi), ‘Forskjellen mellom TCO, LCC og LCA’ (Eng: The Difference between TCO, LCC and LCA) 18 September 2018.

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*Figure 1.2* Comparison of C-LCC, E-LCC and S-LCC. Source: David Hunkeler and others (eds), *Environmental Life Cycle Costing* (1st ed, CRC Press 2008).
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While challenges exist in defining and implementing LCC methodologies, LCC can be an important instrument at several stages of the procurement cycle (e.g., needs analysis, estimate costs, evaluation of tenders) and an important step towards more green and socially responsible public procurement.

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