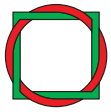

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Forming the Nucleus of a Novel Ecological Accounting System: the myEcoCost Approach

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Abstract. The limited data availability, transparency and harmonisation in environmental assessments of products are bottlenecks for improved environmental and sustainability governance. Despite the progressive developments of information and communication systems, reliable, accurate, up-to-date data for assessing the resource use of products and services is still lacking. Resource accounting systems often have limited scope on single companies, processes or products. This paper presents an approach for an automated bottom-up accounting system for measuring resource efficiency at product and service level. It is based on a global collaborative network of resource accounting nodes connected for the accounting of natural resources use for products and services. Using an Internet-based service-oriented architecture, relevant and timely data is passed from supplier to customer recursively through the whole value chain to produce an “ecoCost” for each product or service. This conceptual paper reflects first experiences from partners of the myEcoCost project funded by European Commission (www.myecocost.com).

Introduction

The promotion of green products and resource efficiency have become two important policy objectives in Europe. For example, the Single Market for Green Products initiative [1] of the European Commision proposes to establish methods to measure environmental performance throughout the lifecycle. The European Commission's "Roadmap to a Resource Efficient Europe" [2] defines policy goals to improve resource efficiency in the business sector, e.g. for 2020, the following milestone is proposed: " … incentives have stimulated new innovations in resource efficient production methods that are widely used. All companies, and their investors, can measure and benchmark their lifecycle resource efficiency. Economic growth and wellbeing is decoupled from resource inputs and come primarily from increases in the value of products and associated services." [2]

A critical problem for implementing these policy objectives and measuring and resource use at product level is data quality and consistency. There are different techniques for data gathering, and data are often out of date or estimated using a wide range of assumptions and mathematical factors. In addition and despite efforts to harmonise the environmental impact assessment models, varying assessment methods make comparing results practically impossible. The myEcoCost project funded by the European Commission (www.myecocost.com) addresses this data quality issue of resource use and material flows by developing a fully integrated data gathering methodology and an accompanying software system to express usage of natural resources for products, services and technologies, to inform economic actors on environmentally relevant information with dynamically calculated, near real time figures.

This paper provides a short summary of the approach to develop an automated bottom-up accounting system for measuring resource efficiency at product and service level. It presents the concept of the myEcoCost project with specific focus on resource accounting, as well as first results of the project with respect to functional requirements for the accounting system. Also, conclusions on further steps are drawn.

Approach of the New Accounting System

The *broad vision of the myEcoCost project* is a cost effective accounting system for natural resources with large scale applicability in the global economy. It aims to support various environmental accounting and assessment practices applicable to national and international environment policy objectives. Therefore, the project aims at researching and developing key Information and Communication Technology (ICT) and software elements to demonstrate the resource accounting framework and infrastructure in a proof-of-concept prototype to be presented to users, environmental data processors and policy makers. The original emphasis of this project is laid on informing three user groups: product designers and procurement staff in industry, and consumers. Restricted in scope to a few products, virtual supply chains will be used for the end-of-project demonstration.

The work in the myEcoCost project is organised into seven work packages (WPs), as illustrated in the Fig. 1 below.

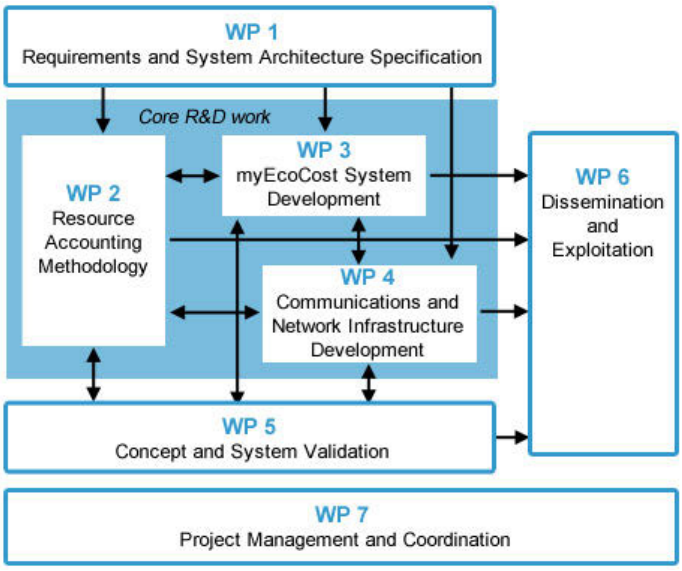

Fig. 1: Illustration of myEcoCost project structure

WP 2, 3 and 4 form the core research and development work. They deal with the resource accounting methodology definition in the environmental and economic domain and with a complete software and communication technology development and integration process. These WPs are preceded by the specification of the myEcoCost system and architecture in WP 1 started from application scenarios. Then they are completed by a comprehensive cross-cutting set of validation and demonstration activities in WP 5. Supported by sound project coordination (WP 7), these key thematic and development activities feed into a strategic and ambitious dissemination and exploitation programme (WP 6).

The myEcoCost approach involves embedding an eco-accounting module alongside existing financial accounting systems. This way, regular and consistent eco-accounting can be introduced into businesses of all sizes and sow the seed for a new era of eco-awareness in everyday life. To promote this new eco-awareness regarding resources, relevant and meaningful data needs to accompany the existing flow of goods and services. A data flow of ecoCosts will be introduced, running in parallel to the money flow which is currently the dominating information in most accounting systems. Compatibility with environmental management and accounting systems will be strived for [3]. During the project a series of ICT infrastructure components will be arranged:

- a resource accounting calculation rules to determine “ecoCosts”,
- an ICT delivery mechanism to transfer the measurement from supplier to customer,
- benchmark figures for companies and consumers linking to macro level policy objectives, and
- interfaces for industry and consumers to interpret the measurement to assist decision making.

The components will be integrated in a software setup that forms the nucleus of the whole myEcoCost system, which is illustrated in Fig. 2 below for one value chain. It will deal with the receipt of all goods and services accepted by the business, the aggregation and

allocation of overheads, the calculation (of ecoCost) of freshly produced products, and the transmission of ecoCost information to the customer. Each ecoCost accounting module will represent a node in a *global collaborative network* of resource accounting nodes whereby each one communicates through the myEcoCost servers with the next node in the value chain. Each module will store „proprietary data“ and release the relevant data on to the next nodes in the value chain until it reaches its final destination, the end consumer. Here, the data can be used e.g. for assessing personal environmental footprints.

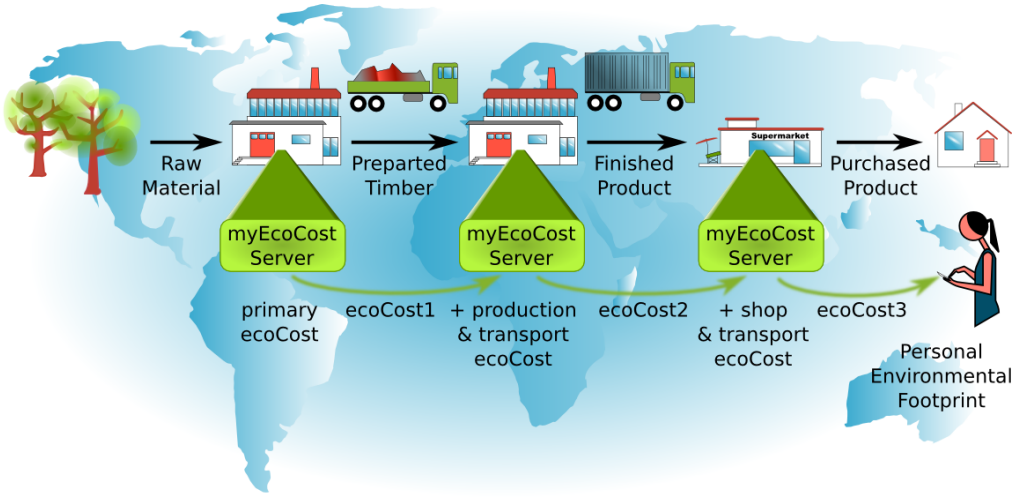

Fig. 2: Illustration of environmental data flow in the accounting system

Regarding the resource accounting rules, a specific accounting framework will be developed based on a review of existing accounting frameworks e.g. from ISO [4] , JRC [5] or other scientific sources [6] aiming at pragmatic and highly automated data gathering. Hereby, Financial and Management Accounting systems will be considered. Financial Accounting communicates information to external stakeholders, for example investors, tax authorities, and it is officially regulated, whereas Management Accounting is intended to support internal decision making and therefore is generally not regulated, as it depends on the specific needs, such as for cost accounting [7]. In Cost Accounting, for example, costs and earnings are addressed; there is no equivalent to the balance sheet of financial accounting. Depending on different assessment methods, various expenditure items in financial accounting correspond to the categories of costs, which are allocated to the respective cost centres (production processes) and cost carriers (products) [8]. The cost accounting correspondence to the financial accounting in meaning of financial statements is shown in table 1.

Financial Accounting	**Cost Accounting**
Balance sheet	-
Assets	No equivalent
Liabilities	No equivalent
Profit and loss account	**Cost Statement**
Expenditure	Cost
Expenditure items	Cost categories
Revenue	Earnings
-	**Cost calculation**
No equivalent	Cost centres (processes)
Calculation of production expenditure	Cost carriers (products)

Table 1: Terminology linkage between Financial and Cost Accounting [8, p. 6]

In order to facilitate the registering procedure, its update as well as the comparison of the outcomes between different time periods, “financial statements” are being used. The four basic financial statements are [7]:

- Income statement (lists revenues and expenses and calculates the company's net income or net loss for a period of time)
- Balance sheet (shows the balance, at a particular time, of each asset, each liability, and owner's equity and also proves that the accounting equation (Assets = Liabilities + Owner's Equity) is in balance)
- Statement of cash flows (tracks the movement of cash during a specific accounting period)
- Statement of owner's equity (shows the beginning and ending owner's equity balances and the items affecting owner's equity during the period)

As many companies do not have a separate cost-accounting system for Environmental Accounting, the Environmental Cost Accounting is based on financial accounting data from bookkeeping. Both bookkeeping and cost accounting can provide with a linked monetary and physically data basis for other instruments such as Environmental Accounting. The registered data from the bookkeeping and cost accounting can include [9]:

- Prices and quantities of pre-productions, raw materials, production and process materials by means of registered incoming invoices
- Costs and amounts of energy/water consumption and waste disposal as derived from the monthly/annual financial statements of the suppliers/waste disposal companies
- Data concerning waste/scrap quantities, disposal routes and incurred costs from the invoices issued by the waste disposal companies
- Costs incurred for handling emissions (e.g. filters)
- Primary (direct) costs of cost centres (e.g. for the material consumption/requirement of individual process/machines)

- Overhead (indirect costs of costs centres - most often production and process cost, administration, lightning, etc.)
- Analysis of the cost trends over time
- Analysis of the cost trends according to cost categories.

Since the financial accounting at company level is obligatory, regardless the country, company size or other factors, the data basis from the well standardised financial accounting could be employed to receive the data for the voluntary environmental accounting such as the myEcoCost accounting. However, financial accounting might not provide data with the reasonable quality for a robust estimation of the resource efficiency. Also the timeliness of the accounting data is an issue.

A myEcoCost accounting node will require a “service” interface, allowing any third party software to communicate with it. With such an interface it is anticipated that existing financial accounting and resource accounting systems will provide the instructions that drive the vast majority of the system. An alternative front end application will be required that is geared toward small businesses that do not require the sophistication of a double entry accounting system. This front end could be used to provide manual interventions for larger organizations on the rare occasions that would be necessary.

The accounting node will have to support multiple companies, multiple divisions within companies, cost centers and projects, to span a wide array of business types and sizes. Consequently it will have to be highly configurable. To support all of the above functionality the system will have a number of distinct functions within it: product specific ecoCost-modeler (used to define the production line of a product), an ecoCost calculation method, overheads accumulation and allocation, depreciation method (to spread the ecoCost of capital items over a number of years), a transmission module, a reporting function and general query facility.

By being connected to and driven by the existing financial accounting system, the ecoCost accounting module benefits from all the checks, balances, procedural safeguards and regulatory frameworks (best practice) provided by that system, thereby fitting into an existing and well known quality control infrastructure.

The final software of the myEcoCost EU project may, in addition to this core, provide additional features and extensions. The focus of this project is the accounting nucleus, communications infrastructure and a core functionality that proves the whole concept and methodology is sound. It must be just as relevant (and affordable) to SMEs as large businesses.

Requirements for the Applicability of the System and Demonstration Scenarios

As a key step with the myEcoCost project, requirements for the myEcoCost software have been identified in WP 1 for the purpose of illustrating the breadth, depth, accuracy and applicability of the system [10]. The requirements gathering process presented a series of business scenarios that spanned the natural course of product flows, from primary production on a farm through the chemical supply chain and manufacturing of household

cleaning products, a service based company, to retailer and to consumer over the logistics chain.

Based on the insights provided by the scenario exploration and on the analysis of additional cross-cutting issues (such as data privacy, policy issues, business decision making), as well as on the devised demonstration towards the end of the project, over 100 system requirements have been identified. They have been classified in the following categories: ecoCost record; data flow; calculation; evaluation; interfaces; data privacy and security; data validity; business users; consumers.

The system requirements obtained are applicable to a long term and broad implementation of the myEcoCost system. In the forthcoming tasks of the project the subset of requirements relevant to the concept validation will be identified.

With the description of the myEcoCost approach, the scenarios explored and the cross-cutting issues analysed, a rather complete view of the myEcoCost system and its approach has been established. As the full implementation of the complete system is out of the scope of the project, a series of demonstration scenarios have been identified for the purpose of illustrating the different aspects of the nucleus of the system. These are planned to be implemented for the pilot demonstration at the end of this project, namely:

- Farm production demonstration: to involve a business at the beginning of a supply chain with specific characteristics regarding ecological accounting and usage of natural resources;
- Industry production demonstration: to involve a business in the middle of the supply chain having an indirect usage of natural resources;
- Retail and consumer demonstration: to involve a business at the end of the supply chain and the consumer, whose acceptance and usage is key to the success of the whole system;
- Configuration demonstration: to demonstrate that different configurations in the ecoCost record and/or in its calculation can be accommodated to fulfil the needs of different businesses, showing in this way the modularity and flexibility of the system.

Conclusion

This paper presents an innovative approach for the development of a nucleus of an bottom-up accounting system for measuring resource efficiency at product and service level. It is based on a global collaborative network of resource accounting nodes and an Internet-based service-oriented architecture. Building upon this nucleus, the envisaged full myEcoCost system could be implemented, with the modifications and enhancements that will certainly be needed in the following years. Based on this, a cost effective accounting system for natural resources with large scale applicability in the global economy could be promoted. The information system could enable more informed choices, and a transition towards more sustainable consumption life-styles in a resource efficient economy.

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