Green Acquisitions And Lifecycle Management Of Industrial Products In The Circular Economy

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Abstract. The article addresses the issue of green acquisitions which occur within an industrial company focused on reducing inputs while maintaining output (substitution and efficiency). These processes characterize a circular economy oriented on resource efficiency (costs saved by reducing purchasing inputs). In our article, we focus on the industrial procurement practice which can help businesses save money and materials. Besides the possibility to negotiate prices, buyers can influence suppliers to offer products and services in an efficient manner in terms of green resources. The life cycle of industrial products is used to demonstrate the environmental advantages and disadvantages of various options for acquisitions and initiatives to totally reuse them.

1. Introduction
Green acquisition refers to purchasing sustainable products with specific environmental or energy attributes. The connection between public acquisition and the environment is presented in figure 1.

Figure 1. The connection between public acquisition and the environment.

Public authorities are major consumers in Europe, spending some 16% of EU gross domestic product (a sum equivalent with a half of the Germany GDP). Using their purchasing power to choose goods and services that respect the environment, they can make an important contribution to sustainable development. Green public acquisitions cover areas such as: purchase of computers and efficient buildings in terms of energy, wood production office equipment in compliance with environmental rules, recyclable paper, electric cars, public transport more environmentally friendly, organic food in canteens, electricity from renewable energy sources, air conditioning systems complying with state of advanced environmental solutions. Green acquisition must be regarded as a concept or a notion that does not concern only the award (including activities in developing specifications and before signing...
the contract), but a concept that covers a set of activities that begins with identifying the need to eliminate the subject contract concluded to meet the actual need (this approach is specified otherwise in the new generation of green public acquisition legislation). It is necessary to make an appropriate distinction between green acquisition process and green acquisition procedures. Green public acquisition procedures are formal, specific and structured processes, described as "practice" for the award of a contract or the conclusion of a framework agreement therefore represents a sequence of tasks set by reference, to conduct a green acquisition process in a effective and efficient manner. Romanian public acquisition law treats a green acquisition as a process and refers to the following acquisition procedures: open tender, restricted tender, negotiated with or without publication of a contract notice, competitive dialogue and competitive solutions.

2. Methods

Addressing the issue of green acquisitions which occur within an industrial company, I have gained my results from knowledge of the acquisitions specific literature. Based on my experimental observation I have obtained an empirical model named "Eco – Industrial Product Life Cycle Stages and ways to reduce the cost of green acquisitions matrix". I have discovered that there are there metrics that the industrial company managers have to take in consideration: distribution and manufacturing; sales; maintenance &service. Based on my experimental observation I have obtained an empirical model named “Product Life Circular Economy Key Principles and Eco and Industrial Product Life Cycle Stages Matrix”. I have discovered that there are two metrics that the industrial company managers have to take in consideration: research and development and research eco-design and development”. Also the metrics named "Optimize resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles” and "More efficient industrial systems reducing pollution and negative environmental impacts “are the most important Circular Economy Key Principles in this matrix.

3. Results

3.1. Energy Efficient Green Acquisitions (EEGA)

Romanian energy efficiency resource acquisition programs seek to purchase energy savings in the public interest, often through financial or technical assistance. Although the decision process for creating these programs varies and can include government, utilities, consumer groups, and other stakeholders, it is usually a Romanian government entity that gives final approval of the volume of energy savings to be acquired and how it will be funded. Energy Efficient Green Acquisitions process has some activities as follows:

- Start event: to be equated with “the identified and documented need for products, services or energy efficient works”.
- end event: to be equated with " implementation assessment of the achieved contract and extracted lessons learned" in order to be included in the next acquisition process;
- involvement of all factory parties in the acquisitions process (not just the acquisitions department);
- Achieving the expected outcomes must help to proceedings starting with the EEA planning stage.

The activities included in the Energy Efficient Green Acquisitions EEGA are described in the table 1, below:

3.2. Green acquisitions strategies

Basically, the political decision to buy green should not pose problems for Romanian public authorities. In fact, a green acquisition process does not normally require any structural changes by the contracting authority. However, putting the policy into practice will first require some strategic
planning: organizing appropriate training for acquisition departments, ensuring the acquisition departments with access to environmental information, and setting priorities when choosing the contracts most suitable for “greening”. Once this is in place, Romanian contracting authorities will be able to proceed with the proper organization of green public acquisitions procedure. The Romanian managers must assess the staff training needs and ensuring access to environmental information. Acquisitions department should be given the legal, financial and environmental knowledge they need to decide to what extent and where they can be introduced effectively, environmental conditions in the acquisitions procedures if they are set at level to get the best value for money and whether they match the environmental priorities of the contracting authority. It is important that green purchasing policy to be communicated to a large number of stakeholders, including suppliers, contractors or service providers, for them to consider new requirements. Cooperation between acquisitions authorities is another way to improve access to knowledge and know-how in the field of environment and communicate this policy to the stakeholders.

3.3. Setting general priorities for greening your acquisitions

The acquisitions department staff needs to adopt a phased approach. This staff will start with a small range of products and services whose environmental impact is clear or where greener alternatives are easily available and not more expensive (eg recycled paper, energy-efficient office equipment).

| EEGA steps | No. | Activities |
|------------|-----|------------|
| EEGA Planning | 1 | Identify and analyze the need for green acquisition |
| | | - Gathering information |
| | 2 | Assignment documentation |
| | | Defining the subject of contract; selection, team formation; preparation strategy. |
| | 3 | Defining and developing technical specifications and selection criteria |
| | 4 | Definition of the criteria |
| | 5 | Defining and contract development |
| EEGA Ongoing | 6 | Publication of announcement procedure |
| | 7 | Examination of tenders |
| | | - Receiving and opening tenders |
| | | - Checking qualification criteria |
| | 8 | Evaluation of tenders |
| | | - Evaluation of technical capacity |
| | | - Assignment criteria application (choosing the contracts most suitable tenders for "greening") |
| | | - Life cycle cost calculation |
| EEGA End | 9 | Contract award |
| | 10 | Acquisition outcome communication |
| | 11 | Signing the contract |
| EEGA Post ongoing | 12 | Contract Management |
| | 13 | Monitoring implementation of the contract in terms of quality and quantity |

3.4. Considering environmental impact

The acquisitions department staff will select those products (such as vehicle fleet) or services (such as cleaning) that have a major environmental impact. They will consider availability and cost of
environmentally superior alternatives and availability of data. In this case they must be able to get scientific and environmental data necessary to establish criteria for this product. After this, acquisitions department staff will decide what they want technically, and will express it in a call for tender.

3.5. The complex business environment in which company acquisition department is breaking into a new market
A company breaking into a new market with its current product range might need to use innovation in order to manage EEGA contracts (table 1, activity 12) and acquire new manufacturing or sales capabilities (figure 2).

3.6. Green acquisitions goals and ways to reduce costs
Green acquisitions goals are as following: increased profitability or energy efficiency products / services purchased; reducing the cost of green acquisition. Green acquisitions goals and ways to reduce costs are as following:
Reducing prices: merging orders; negotiating more favourable agreements; buying larger quantities; providing long-term contracts; sharing information; adopt reciprocity method; Reducing costs: reducing the number of suppliers; improving energy efficiency systems; increase employee efficiency; implementing TQM method; implementing JIT method; Implementing E-Acquisitions.

Figure 2. The complex environment in which a company acquisition department is breaking into a new market (source [1] figure 2, page 3)

3.7. Eco – Industrial Product Life Cycle Stages
Recent decades have brought with intense technological development and about the impact of material production and services on the environment, on human health of all living beings and all environmental components. For this reason, all entities producing goods and services, must pay particular attention to how the product works, provide services, mode of operation / use, disposal or recovery / recycling after disposal. This involves analyzing each stage of manufacture of an industrial product and to find out ways to reduce the cost of green acquisitions. The analysis must yield to the environmental impact assessment and the community throughout the product chain of existence. It is improperly called life cycle, concerned not only a material thing or service, but suggestively, was adopted the same formula as in the case of living beings. Right it should be formulated as "Eco – Industrial Product Life Cycle" of the product, from manufacturing to disposal, after use. If outline the
life cycle of a material good, we can better understand and assess the impact on the environment and community at stages of production, operation and decommissioning then. We have realized "Eco – Industrial Product Life Cycle Stages and ways to reduce the cost of green acquisitions Matrix" (table 2) in order to identify the relationship between the ways to reduce the cost of green acquisitions (reducing prices and reducing costs) and Eco – Industrial Product Life Cycle Stages. The Eco – Industrial Product Life Cycle Stages are the follows: market needs for green industrial products; research and development; idea generation; opportunity identification and concept definition; research eco-design and development; prototype & production; distribution and manufacturing; eco-marketing; sales; maintenance & service; products feed-back; removal, disposal and recycling. As we can see in the matrix" distribution and manufacturing" lifecycle stage" has the highest score: 11. Another two lifecycle stages ("Sales; maintenance & service") have a high score: 9. In this case, the industrial company managers have to take in consideration that these three metrics are very important, because they could affect the entire eco – industrial product life cycle. Also the metrics named" Sharing information" (score 9) and" Implementing TQM method" (score 8) are the most important ways to reduce the cost of green acquisitions.

Table 2 Eco – Industrial Product Life Cycle Stages and ways to reduce the cost of green acquisitions

| Eco – Industrial Product Life Cycle Stages | Reducing prices | Reducing costs |
|------------------------------------------|-----------------|---------------|
|                                          | Merging orders  | Negotiating more favourable agreements |
|                                          | Buying larger quantities | Providing long-term contracts |
|                                          | Sharing information | Adopt reciprocity method |
|                                          | Reducing the number of suppliers | Improving energy efficiency systems |
|                                          | Increase employee efficiency | Implementing TQM method |
|                                          | Implementing JIT method | Implementing E-Acquisitions |
|                                          | Total scores     | Weighted score (%) |

|   | (1) | (2) | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|-----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | Market needs for green industrial products | - | X | - | X | X | X | - | - | X | X | X | X | 8 | | 12.13 |
| 2 | Research and development | - | - | - | - | X | X | - | X | - | X | X | X | 6 | | 09.09 |
| 3 | Idea generation | - | - | - | - | - | - | - | - | X | - | X | X | - | 3 | | 04.54 |
| 4 | Opportunity identification and concept definition | - | - | - | - | X | X | - | X | - | - | - | X | 4 | | 06.06 |
|   | Research eco-design and development | Prototype & production | Distribution and manufacturing | Eco-Marketing | Sales | Maintenance & service | Products feedback | Removal & disposal and recycling | Total scores | Weighted score (%) |
|---|-----------------------------------|------------------------|--------------------------------|---------------|-------|----------------------|------------------|---------------------------------|--------------|-------------------|
| 5 | -                                 | -                      | X                               | X             | X     | X                    | X                | X                               | 4            | 06.06             |
| 6 | -                                 | X                      | X                               | X             | X     | X                    | X                | X                               | 6            | 09.09             |
| 7 | X                                 | X                      | X                               | X             | X     | X                    | X                | X                               | -            | 11                |
| 8 | -                                 | X                      | -                               | X             | -     | -                    | -                | -                               | 2            | 03.03             |
| 9 | X                                 | X                      | X                               | X             | X     | X                    | X                | X                               | 9            | 13.64             |
| 10| X                                 | X                      | X                               | X             | X     | X                    | -                | X                               | 9            | 13.64             |
| 11| -                                 | -                      | -                               | X             | -     | -                    | X                | -                               | 2            | 03.03             |
| 12| -                                 | -                      | -                               | X             | -     | -                    | X                | -                               | 2            | 03.03             |

| Total scores | 3 5 3 4 9 5 2 6 7 8 7 7 66 100 |

| Weighted score (%) | 04.54 7.57 04.54 06.06 13.64 7.57 03.03 09.09 10.61 12.13 10.61 10.61 100 100 |

3.8. Circular economy key principles (table 3, source [3])

In the case of industrial products, circular economy is based on three key principles:

**Principle 1:** Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows. This starts by dematerializing utility - delivering utility virtually, whenever optimal. When resources are needed, the circular system selects them wisely and chooses technologies...
and processes that use renewable or better-performing resources, where possible. A circular economy also enhances natural capital by encouraging flows of nutrients within the system and creating the conditions for the regeneration of, for example, soil.

![Circular economy concept](image)

**Figure 3.** Circular economy concept. Source [2]

*Principle 2: Optimize resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles.*

This means designing for remanufacturing, refurbishing, and recycling to keep technical components and materials circulating in and contributing to the economy. Circular systems use tighter, inner loops (e.g. maintenance, rather than recycling) whenever possible, thereby preserving more embedded energy and other value. These systems also maximize the number of consecutive cycles and/or the time spent in each cycle, by extending product life and optimizing reuse. Sharing in turn increases product utilization. Circular systems also encourage biological nutrients to re-enter the biosphere safely for decomposition to become valuable feedstock for a new cycle. In the biological cycle, products are designed by intention to be consumed or metabolized by the economy and regenerate new resource value. For biological materials, the essence of value creation lies in the opportunity to extract additional value from products and materials by cascading them through other applications. As in any linear system, pursuing yield gains across all these levers is useful and requires continued system improvements. But unlike a linear system, a circular one would not compromise effectiveness.

*Principle 3: Foster system effectiveness by revealing and designing out negative externalities.* This includes reducing damage to systems and areas such as food, mobility, shelter, education, health, and entertainment, and managing externalities, such as land use, air, water and noise pollution, and the release of toxic substances. In our industrial case that means more efficient industrial systems by reducing pollution and negative environmental impacts.

We have realized "Product Life Circular Economy Key Principles and Eco and Industrial Product Life Cycle Stages Matrix" (table 3) in order to identify the relationship between Circular Economy Key Principles and Eco – Industrial Product Life Cycle Stages. As we can see in the matrix "Research and development" and "Research eco-design and development” lifecycle stages" have the highest score: 3. In this case, the industrial company managers have to take in consideration that these two metrics are very important, because they could affect the entire eco –industrial product life cycle. Also the metrics named "Optimize resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles” (score 9) and "More efficient industrial systems reducing pollution and
negative environmental impacts” (score 10) are the most important Circular Economy Key Principles in this matrix.

### Table 3. Product Life Circular Economy Key Principles and Eco and Industrial Product Life Cycle Stages Matrix (Adapted by the authors from source: [1]; [3])

| No. | Eco – Industrial Product Life Cycle Stages | Circular Economy Key Principles (industrial products) | Total scores | Weighted score (%) |
|-----|------------------------------------------|-----------------------------------------------|--------------|-------------------|
|     | Preserving and enhancing natural capital stocks by controlling finite and renewable resources balancing flows | Optimise resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles |                        |                   |
|     | More efficient industrial systems reducing pollution and negative environmental impacts | Total scores | Weighted score (%) |
|     |                                          | (1)      | (2)      | (3)      | (4)      | (5)      | (6)      | (7)      | (8)      | (9)      | (10)     | (11)     | (12)     | (13)     | (14)     | (15)     |
| 1   | Market needs for green industrial products | X        | -        | X        | 2        | 8.69     |            |            |            |            |            |            |            |            |            |            |
| 2   | Research and development                  | X        | X        | X        | 3        | 13.05    |            |            |            |            |            |            |            |            |            |
| 3   | Idea generation                           | -        | X        | X        | 2        | 8.69     |            |            |            |            |            |            |            |            |            |
| 4   | Opportunity identification and concept definition | -        | X        | X        | 2        | 8.69     |            |            |            |            |            |            |            |            |            |
| 5   | Research eco-design and development        | X        | X        | X        | 3        | 13.05    |            |            |            |            |            |            |            |            |            |
| 6   | Prototype, production                     | -        | X        | X        | 2        | 8.69     |            |            |            |            |            |            |            |            |            |
| 7   | Distribution and manufacturing             | X        | X        | X        | 3        | 13.05    |            |            |            |            |            |            |            |            |            |
| 8   | Eco-Marketing                             | -        | -        | X        | 1        | 4.35     |            |            |            |            |            |            |            |            |            |
| 9   | Sales                                    | -        | -        | X        | 1        | 4.35     |            |            |            |            |            |            |            |            |            |
| 10  | Maintenance /service                       | -        | X        | -        | 1        | 4.35     |            |            |            |            |            |            |            |            |            |
| 11  | Products feed-back                        | -        | X        | -        | 1        | 4.35     |            |            |            |            |            |            |            |            |            |
| 12  | Removal & disposal and recycling           | -        | X        | X        | 2        | 8.69     |            |            |            |            |            |            |            |            |            |
|     | **Total scores**                          | 4        | 9        | 10       | 23       | 100      |            |            |            |            |            |            |            |            |            |
|     | **Weighted score (%)**                    | 17.40    | 39.13    | 43.47    | 100      | 100      |            |            |            |            |            |            |            |            |            |
4. Conclusions
Green acquisitions is also about influencing the green market. By promoting green acquisitions, public authorities can provide industry with real incentives for developing green technologies. In some sectors of industrial productions, the impact can be significant, because public purchasers command a large share of the market (computers industry, energy efficient buildings, public transportation industry etc.). If we take into account the costs of an entire Eco – Industrial Product Life Cycle of a contract, green public acquisitions give the opportunities to save public money and to protect the environment at the same time. By acquiring wisely, we can save materials and energy, we can reduce waste and pollution and encourage sustainable patterns of consumer behavior.

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