CIRCULAR ECONOMY IN THE MANUFACTURING INDUSTRY: PRACTICAL LESSONS

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After months of working with companies to incorporate the circular economy into their business model, we can draw conclusions beyond the macroeconomic confrontation between the circular economy and the traditional economy.

As an alternative to the traditional economy, the circular economy presents an approach that tries to break the linearity established in production processes -produce, use and throw away- to try to keep products in operation for as long as possible, that is, to extend their useful life to the limit and, when this ends, to try to recover the resources of which these products are made (not waste if we adopt the circular vision) to incorporate them again in another production process.

This approach, which is conceptually very attractive and on which a broad theoretical framework has already been developed, clashes head-on with the prevailing inertia of the capitalist economy, especially in the most developed countries. Even so, thanks to the increasingly widespread assimilation of the internalisation of environmental costs, the economic valuation of ecosystem services, the application of cost-benefit analysis methodologies incorporating the social and environmental aspects, or the adoption of new technologies that allow waste to be recovered and turned into resources, different aspects contemplated by the circular economy are gradually being incorporated both at national and company level.

NAIDER has been working for some time now in the field of the circular economy, one of our latest initiatives being the CICLO Project. After the first months of work with a number of companies that we are assisting to incorporate the circular economy into their business model, we can draw several preliminary conclusions that, beyond the macroeconomic confrontation between circular economy and traditional economy, shed some light when we apply the theory to practical and real cases.

Although we are working with 8 productive companies, in order to draw preliminary conclusions we have selected **industrial companies from the manufacturing sector** (CNAE-25: Manufacture of metal products; the other two are graphic industries), which amount to a total of 6, all of them from the Basque Country, spread over a range of between 6 and 75 employees, and between 1 and 15M€ in turnover.

The lessons we are learning during the development of the CICLO project are ordered according to one of the most established methodological frameworks, ReSOLVE (**Regenerate, Share, Optimize, Loop, Virtualize, Exchange**), which establishes six priority areas for action: **Regenerate, Share, Optimize, Close the loop, Servitise, Exchange**.

The ReSOLVE Framework. Source: Ellen MacArthur Foundation

Regenerate

Several of the companies we work with have incorporated or have projects to install **renewable energy systems** in their facilities, in particular solar panels on the roofs of their warehouses. Their own suppliers offer them this possibility at very advantageous conditions, so with some financial capacity the companies already see this type of investment as profitable in the medium term. Although these installations contribute to reducing the **energy bill** of these companies, one of the critical costs in this manufacturing sector, they are not intended to intervene directly in the production process. As they are **energy-intensive** companies, in general, efficiency and optimisation in the contract with the energy company are closely controlled. We have detected the need to **monitor energy consumption specifically for each machine**, something that can already be done with the digitalisation of machinery, but it is not very widespread. In any case, the r**eplacement of machinery is always determined by the amortisation periods of the machines**, a matter that is perfectly controlled by those responsible for production and management. In addition, there is also the paradox of efficiency, whereby, even if a machine is more efficient per unit of product, it is used more than the previous one to produce even more, with the consequent increase in energy consumption. This action area of the ReSOLVE framework also refers to the **use of renewable materials**. All the companies now in the CICLO project use different types of metal as their main raw material. It is not a renewable resource, but given its composition and value, it is managed from a circular perspective, although the companies use the corresponding waste managers to recover the waste generated in the production process, or it is the end user of the product who, after the end of its useful life, is responsible for reintroducing the material (again via a waste manager) into another production process.

Share

The companies we work with **manufacture metal parts** for different sectors: automotive, machine tools, railway sector, etc. These parts, of different sizes and material compositions, generally have very demanding quality standards determined by the customers of these companies. They are **parts designed in advance to maximise their service life**. Apart from the ordinary maintenance of the equipment in which these parts are inserted, no other operations are contemplated to extend their useful life. In fact, **they are not remanufactured parts that provide a second life**, so they are simply discarded when their useful life is over. Following the ReSOLVE conceptual framework, in general, companies in this manufacturing sector do not share resources with other companies, nor do they jointly purchase raw materials to optimise costs. Although these companies share certain characteristics of the sector, each of them has a very specific business model with a high degree of specialisation that does not make such collaboration possible. At most, some companies have told us that they lend each other measuring tools, or that certain manufacturing operations (such as cutting, for example) are carried out for other companies in the sector, but more in the sense of a normal commercial relationship.

Optimize

This is ReSOLVE's key area of action, which is also related to the other areas established by this theoretical framework. The optimisation of production processes is an inherent aspect of any company, as we have also seen in the companies we work with in the CICLO project. Every company, in order to be successful, tries to maximise profits and minimise costs. **The machinery used for the manufacture of metal parts**, both milling machines and cutting tools, furnaces, etc. is key to the production processes, and as we mentioned before, its renewal is mainly determined by the amortisation period. When the amortisation period is met, the machines tend to continue to be used as long as a technological improvement that substantially increases efficiency is not detected, and if this situation arises, the company's financial capacity to face the investment involved in the purchase of the new machine is decisive. That is, in the CICLO project we detected that **this improvement in efficiency is mainly determined by financial aspects related to the business model of each company**. As for reducing or minimising waste, the very logic of the production process, which is aimed at minimising losses and optimising the use of raw materials, leads companies to be extremely efficient when manufacturing metal parts. The waste, apart from engine oil, drilling oil, etc., is mainly metal shavings and scraps, which are collected by an authorised manager who pays the manufacturing company, as this is a material with a market value. We have detected an opportunity for improvement in terms of optimisation when it comes to **monitoring the energy consumption of each machine in a particular way**, something that is already possible with the technology currently used in this equipment but which is not yet used by the companies to find out, for example, the **energy consumption per unit produced**.

Close the cycle

As we mentioned in the previous point, **scrap metal** represents a considerable volume of waste in this type of manufacturing companies. **This waste has a considerable market value**, so waste managers are responsible for collecting it from the companies, which also obtain a certain economic return for it. This waste, passing through the corresponding revaluation process (e.g. smelting), thus becomes the **raw material for another production process**, although in this case the circle is closed externally to the manufacturing company. Among the companies we work with in the CICLO project, we have not detected any that prioritise the use of recycled metal. In general, companies must respond to the requirements and specifications of their clients, and they tend to prioritise local suppliers not so much for their proximity but for their capacity for immediate response. In addition, we have detected another closing of the circle, also external to the manufacturing company, in terms of **cutting tools** which, once they have worn out, the same supplier is responsible for collecting them, paying the company for the material. Finally, it should be noted that some companies have set up closed circuits for the **cleaning of industrial oils used in certain milling and cutting operations**, so that purification plants have been installed that allow this oil to be reused.

Servitise

This is the area of action of the ReSOLVE theoretical framework which, given the characteristics of the metal product manufacturing sector, we have found to be less represented among the companies participating in the CICLO project. Although in Spain and the Basque Country there is a progressive incorporation of services by manufacturing companies, we at NAIDER perceive that this is not so marked among the companies with which we are in contact. For example, as far as industrial design services are concerned, all the companies in the CICLO project work to drawings, i.e. **the design is totally determined by the client**, and in general there is hardly any room for manoeuvre to make modifications to the design. We have observed that practically all the companies have their own quality and metrology services, although this is more a consequence of the need to comply with the client's standards. As a result of conversations with some of these companies, we have been given examples of the manufacture of metal parts (specifically, in the case of large industrial fasteners) which, with the incorporation of technology, allow for real-time monitoring of their operation, so that the supplying company can offer a **personalised maintenance service**, and not just the sale of the part itself.

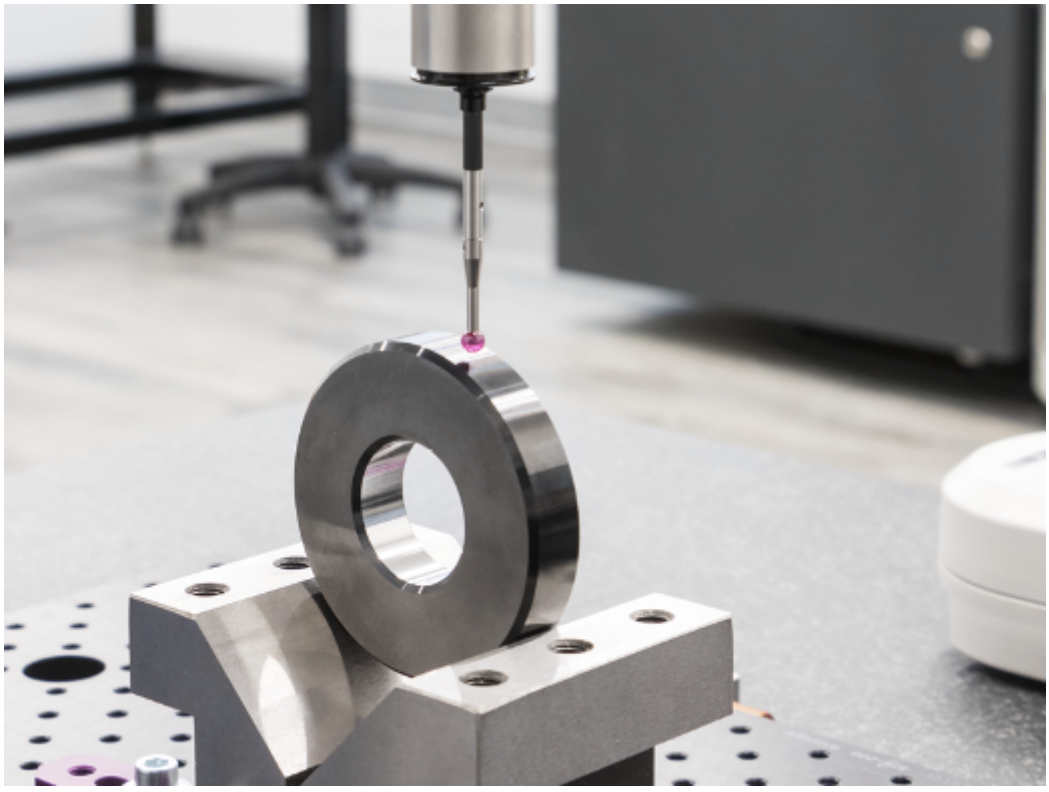
Exchange

In relation to the main raw material of the companies we work with in the CICLO project, metal, **the decision to purchase the material is mainly determined by the technical specifications required by the client and by the nature of the production process chosen by each company**. For the time being, we have not detected any conditioning factors that make companies choose a material that comes from recycled metal. For reasons of rules and regulations related to toxic substances, there are certain treatments on metal parts that have been replaced by others that use substances that are not so harmful to the environment. With regard to the replacement of production processes, this area of action of the ReSOLVE framework refers to 3D printing; at present, this technology is not viable to produce metal parts with such high technical requirements as those manufactured by the companies we work with.

As a preliminary conclusion, it is worth mentioning that **ReSOLVE is a theoretical framework with a systemic approach** that, when applied to concrete examples such as those we have presented, requires some conceptual adaptation. Even so, this framework, which offers different options for incorporating the circular economy at country or regional level, **is valid for exploring these alternatives in companies**. The CICLO project, currently under development, has also allowed us to contrast this theoretical framework with real examples of companies that manufacture metal parts. These companies, themselves suppliers of large automotive or railway companies, among others, **have very little room for manoeuvre to develop, for example, eco-design actions**, since, as has been pointed out, they are companies that work on the basis of a design supplied by the client and on which few improvements can be proposed.

Something similar can be said about **raw materials**, with hardly any possibility of using alternative materials, either due to customer requirements or to the technical specifications of the production process. Everything related to **waste management** has been found to be perfectly controlled by the companies, and in the case of metal waste, it is difficult to reintroduce it into the companies' own production process, as they would have to open another line of business related to foundry.

Over the next few months we will continue working on the CICLO project, hoping to extend the experience to other manufacturing companies in our area during 2024, helping them to implement circularity actions in their production processes based on the conclusions we have described throughout this article.



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