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Natural capital visibility in financial accounting – Method 3 – Extended Version

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1. Overview

Schematically, the CARE (Comprehensive Accounting in Respect of Ecology)² model is based on:

- an inclusion of **social and environmental issues in the balance sheet and income statement**;
- an extension of financial solvency to **“environmental” and “social solvency”**;
- an extension of the principles of protection of financial capital to natural and social capitals.

In this context, **social and environmental issues**:

- are addressed through **the conservation (maintenance) of “capital” “entities” to be preserved** (climate, biodiversity, soils, human beings employed, *etc.*). **Each of the entities is a specific (natural or social) “capital”** (a “capital” entity to be preserved);
- reflected in the balance sheet and income statement by the **recognition of social and environmental liabilities** (debts).

As a consequence, natural and social capitals, conceived as liabilities, are **valued at their preservation costs** (prevention or restoration – not compensation – costs). **Assets are uses of (financial, natural and social) capitals. The income is the surplus of revenues after all the capitals have been maintained (preserved).**

CARE is therefore a (direct) **extension of Historical Cost Accounting** and its principles.

To be fully operational, CARE ultimately needs to be articulated with an **“ecosystem-centred accounting” model**, that accounts for the ecological performances reached at the level of the collective management of a given natural capital entity.

Most of the results of the on-going experiments of CARE **cannot be reported to respect confidentiality**. In this report, we will simply draw from these real cases to provide schematic examples.

- Case 1: Real estate company (global real estate operator of a French multinational) / experiment on one site / Location: France / real data completed by scenarios (for budgets)
- Case 2: Farm / experiment on one site / Location: France / real data completed by scenarios (for budgets)
- Case 3: Creche (Childcare) / Experiment on one site / Location: France / real data completed by scenarios (for budgets)
- General results based also on some examples from a series of current experiments in south of France (named “Collective Operation”), in different sectors - industrial, distribution, *etc.* - and ranging from SMEs to multinationals (see part 2).

2. Context

CARE was introduced in Richard (2012) and developed in particular in Rambaud & Richard (2015b), Rambaud (2015) and Richard, Bensadon, & Rambaud (2018). It is **part of an ongoing research and development programme** (Richard *et al.*, 2018), involving academics, business and civil society, at the interface between management sciences, economics, environmental sciences, sociology and history.

At the development level, various phases of the model's progress have been tested and are being tested, in particular through consulting firms and associations:

- the R&D section of the **consulting firm “Compta Durable”**³ is dedicated to this model. From 2016 to 2018, it experimented a previous version of CARE in a creche, a real estate company and a farm. Since April 2019, this firm has been conducting an experiment (Collective Operation) of the latest version of CARE, involving **ten companies** (in different sectors - industrial, distribution, *etc.* - and ranging from SMEs to multinationals), in the south of

² The term “Ecology” in the acronym CARE is in no way a synonym of “environmentalism”, but must be understood in its initial and fundamental meaning: the interrelations of humans and non-human “entities”, in which we include all living conditions in a broad sense. Therefore “Ecology” encompasses social and natural issues as entangled issues.

³ <http://www.compta-durable.com/>

France, in partnership with **ADEME⁴ (French environment and energy management agency)** and the **INEC⁵ (French Circular Economy Institute)**, with the support of the **Haut-commissariat à l'Économie Sociale et Solidaire et à l'Innovation Sociale⁶** (attached to the French Ministry of Environment).

- the principles of CARE are used by the **"Fermes d'Avenir"⁷ network** as a basis for their advocacy for "triple capital" (or rather "multi-capital") accounting, for the deployment of this model in the context of farms.
- a previous version of CARE was tested in the **"Bergerie Nationale"⁸**, in the framework of a PhD thesis (Altukhova, 2013); this experiment is being updated.
- the latest version of CARE is also being tested within the framework of the French group **"Carrefour"**.

At the academic level, several research projects⁹ and research chairs¹⁰, including one entitled "Ecological Accounting"¹¹ (Academic partners: AgroParisTech, Paris-Dauphine University, University of Reims-Champagne-Ardenne/Funding Partners: LVMH, "Compta Durable", Association of Chartered Accountants of Paris-Ile de France, CDC Biodiversité¹², French Ministry of Environment, "Vertigo Lab"¹³), collaborate in theorizing and developing the model and its socio-economic consequences. CARE is also taught (and will be taught) in some training courses (Paris-Dauphine University, AgroParisTech, Kedge Business School). In this context, several PhD theses deal with CARE in various fields (in particular, in agricultural and distribution sectors) (Altukhova, 2013; Ionescu, 2016; Rambaud, 2015; Taibi, 2019). For instance, PhD theses are in progress and will begin in 2020 on **"LVMH"** and **"Fleury-Michon"** sites (agricultural and agro-industrial sectors).

At the institutional level, CARE is included in several reports (De Cambourg, Gardes, & Viard, 2019; Finance Watch, 2019; Notat & Senard, 2018; WWF France & AXA, 2019) and is the subject of a number of recommendations (Rambaud & Richard, 2016), notably from the French Economic, Social and Environmental Council (Abel & Blanc, 2017; Pasquier, 2018), while also contributing to debates within organizations such as the French Society of Financial Analysts, the French Association of Chartered Accountants, the French accounting standard setter or the French Ministry of Environment.

2.1 Links to current accounting practices

CARE was created to address the **following gaps in the current financial accounting approach**:

- lack of **dedicated accounts for environmental and social issues**;
- failure to **articulate financial and non-financial data** as well as **financial and socio-environmental impacts**;
- lack of **environmental and social (scientific) objectives**, including in the case of provisions;
- lack of emphasis on **investments for an ecological transition** and on **environmental and social expenditures (to prevent and restore)**;
- no distinction between **operating activities and activities to reduce or avoid negative socio-environmental impacts**;
- **asymmetry of treatment between financial, environmental and social issues**, contrary to the demands of sustainable development. In particular, **absence of environmental and social solvency**. Moreover, the **today's integration of some non-financial information is conceived mainly from the perspective of the (negative and positive) impacts of (natural and social) environment on business, and not from the impacts of business on the (natural and social) environment** (Capron & Quairel, 2015; Jones, Comfort, & Hillier, 2016);
- lack of **shared governance with stakeholders**: financial accounting does not really serve the public interest (especially for IFRS);

⁴ <https://www.ademe.fr/>

⁵ <https://institut-economie-circulaire.fr/>

⁶ <https://www.ecologique-solidaire.gouv.fr/ministere/haut-commissaire-leconomie-sociale-et-solidaire-et-linnovation-sociale>

⁷ <https://fermesdavenir.org/>

⁸ French National Sheep-fold - <http://www.bergerie-nationale.educagri.fr/>

⁹ With funding from Institut Europlace de Finance, Louis Bachelier Institute and the "Autorité des Normes Comptables" (French accounting standard setter).

¹⁰ Another chair involved in the development of CARE is the chair "Evaluer et Rendre Compte de la Performance Globale" ("Evaluating and Reporting on Global Performance") (La Rochelle Business School / Fleury-Michon, Spread & Cole).

¹¹ Inaugurated in presence of the president of the French accounting standard setter, of the French High Commissioner for the Social and Solidarity Economy and of the Director General of the European Commission's Directorate General (DG) for Environment. They intervened to support this initiative.

¹² <https://www.cdc-biodiversite.fr/> (CDC: French public company "Caisse des Dépôts et des Consignations")

¹³ <http://vertigolab.eu/>

- lack of **fully “integrated” performance**: this situation leads to separating financial and non-financial analyses/notations;
- lack of **consideration of longer time periods**; prevalence (in particular, in the case of IFRS standards) of short-term values.

As a consequence, **the today’s measured profit/profitability may not be sustainable, but made at the expense of “capital” (natural and human) “entities” to be preserved.**

Moreover, as explained below, **some of these issues are also present in some today’s proposals of integrated reporting or environmental extension of financial accounting.**

In broad outline, CARE is a **“natural” extension of the concept of liabilities, assets, expenses, revenues and income in line with Historical Cost Accounting theory.** For these reasons, CARE is **adaptable to *the very structure and theory of most national accounting standards*** (like French GAAP), but with a **need for in-depth evolution of these ones** (in particular, to include new types of liabilities and assets) (see part 4.2).

2.1.1 *Capital (financial & extra-financial)*

To address these issues, CARE is firstly based on an analysis of the notion of “capital” and its implications in the non-financial context. Broadly speaking, there are two opposite interpretations of the concept of (financial) capital, which accounting is able to distinguish. “Capital” is:

1. (Model 1) either “money to be repaid”, disconnected from the notion of interest;
2. (Model 2) or a set of productive resources/a productive fund, generating, through its control, money or services. In this context, a machine, for instance, can be “capital”. In this way, money is not capital, but it is productive money (money’s worth) that is “capital”.

The first conception corresponds to the historical origin of the term “capital”: capital is etymologically the main, the *capital*, part of a debt, the part to be repaid/preserved over time, regardless of any interest (Braudel, 1992). These two concepts have profound and contrasted consequences for financial accounting and economics. We can sum up these consequences in this way (Finance Watch, 2019; Rambaud, 2017; Rambaud & Richard, 2015a):

Table 1: The two conceptions of "capital" and their links to accounting

	Model 1	Model 2
Capital	Capital is money to be repaid, not intrinsically productive. It is the realization of an operating process that creates an <i>ex-post</i> profit. Capital is <i>independent</i> from the activity of the firm.	Capital is a set of productive resources and/or productive money, generating, <i>intrinsically</i> , stream of future cash-flows. Capital is dependent on the activity of the firm (the stream of cash-flows depends of the activity) ¹⁴ .
Capital & income	Capital and income are strictly separated	Capital and income are inter-defined (Kaldor, 1955)
Capital & balance sheet	Capital is a credit concept (Nobes, 2015) Focus on the liabilities-side of the balance sheet All liabilities consist of capital, provided, directly or indirectly, by different providers (shareholders, banks, suppliers, etc.). Conceptual equality of these providers.	Capital is a debit concept (defined through assets) (Nobes, 2015) Focus on the assets-side of the balance sheet. Capital is synonymous with Equity. Capital refers only to the owners/shareholders.
Capital & assets	Capital and assets are strictly separated Assets are uses of capital ¹⁵	Capital and assets are interdependent Capital <i>is</i> net assets.
Evaluation	Value of capital is only the value of money to be repaid.	The value of capital is either the sum of the market values of the net assets or the discounted value of the future free cash flows.
Capital maintenance	Maintenance of the "intrinsic essence" of the capital, defined outside the firm (<i>i.e.</i> the value of money provided by different stakeholders).	Maintenance as asset management. Asset management and profit (value) maximisation are inter-defined
"Matter of concerns"	Capital protection/preservation Financial solvency	Capital (assets) management and optimisation
Income	Based on the principle of realization	Possibility of distributing unrealized future gains
Income purpose	Measuring the available surplus, after securing the integrity of the intrinsic essence of the capital (money).	Optimizing the capital (asset) management.
Accounting system	Historical Cost Accounting	Fair Value Accounting

These two interpretations¹⁶ have also important consequences on the concept of "non-financial capital".

2.2 Links to natural capital accounting practices

2.2.1 Natural & human capital as "assets"

An extension of model 2¹⁷ leads to an understanding of "non-financial capital" as a set of non-financial productive resources (non-financial assets) that generate money and services, in particular, for owners/ shareholders in the context of company (Rambaud, 2017). More precisely, natural or human/social capital correspond, thus, to specific natural or human/social features, able to produce money and services, like pollution absorption, pollination, *etc.* or knowledges, skills, *etc...* Therefore, natural capital or human capital is not, for instance, a given ecosystem, *per se* – a particular biophysical and complex entity – or a human being *per se*, but only the recognition that "capital" can have other sources of productivity (natural and human assets)¹⁸. In this way, nature and human beings are mere means for increasing "capital" (value). Reporting natural and human capital can simply lead to a reporting of immaterial assets (natural and human assets), which

¹⁴ There are in fact two different interpretations of capital in model 2: "There are some for whom Real Capital is a Fund – I shall call them Fundists; and there are some for whom it consists of physical goods. [...] I shall [...] call them Materialists" (Hicks, 1974). For fundists, capital is represented by a fund invested in "durable instruments of production which are used as an indivisible entity over and over again in a temporal sequence" (Pekkarinen, 1979); "Fundist" capital is assessed on the basis of discounted value of future cash-flows generated by the fund which represents the capital. For materialists, capital is represented by a stock (set) of things (assets) "of limited life which are periodically worn out or used up and reproduced" (Knight, 1935), and which generate utility/welfare. "Materialist" capital is valued by the aggregation of the market prices and/or Willingness To Pay (To Accept) of each asset of the stock which represents the capital.

¹⁵ e.g. machine is not an asset, but it is the "purchase of this machine" which corresponds to the "real" asset (Ijiri, 1967).

¹⁶ We do not discuss here the consequences of these two approaches on financial accounting. Cf. (Finance Watch, 2019) for such a discussion, in particular about the issue on volatility.

¹⁷ Which is at the core of the <IR> (Integrated Reporting of International Integrated Reporting Council (IIRC Council, 2013)) or of the environmental P&L of Kering.

¹⁸ More precisely, the materialist approach entails that capital is interpreted as the aggregation of natural material things (assets), which represent the natural source of capital, and of other types of assets, as human-made assets, which generate welfare and utility. This approach can be found, for example, in (Hartwick, 1977), (Pearce, 1988) or (Farmer & Bednar-Friedl, 2010). The fundist approach of capital is not based on an enumeration of things but represent capital as a stream of future receipts (Hicks, 1946) or services (Fisher, 1906) : the stake is not to establish a list of all the material elements which are the support of the capital but to assess directly what is the level of services generated by the utilisation of different types of assets. Therefore, the fundist perspective on "natural Capital" (El Serafy, 1991) considers that future receipts or services are partially provided by some natural things, but it is not relevant or possible to determine the contribution of a particular natural asset. In this way, natural capital is only a particular stream of future receipts.

constitute a part/an explanation of the *internally generated goodwill* (in the Fundist interpretation of capital). From this perspective, the value of natural or human capital is based either on market values, extended to virtual market values assessed by Willingness-To-Pay/Willingness-To-Accept of consumers, of natural assets (in the materialist perspective) or on discounted future free cash-flows generated by natural or human things (in the fundist perspective) (Rambaud, 2017).

Furthermore, from this perspective, the levels of preservation of natural entities, like biodiversity, plant and animal population, or climate, are *the result of a Cost-Benefit Analysis*, included the value of natural and human capital eventually lost. **Perhaps paradoxically, this approach systematically leads to environmental degradation** (Clark, 1973; Godard, 2004; Pearce, 1976). For instance, Pearce (1976) proved that the optimum production, even with an internalization of (positive and negative) externalities in the Cost-Benefit Analysis, is always beyond the regeneration capacities of the exploited ecosystems.

2.2.2 *Natural & human capital as “liabilities”*

Sustainable Development, from a strong sustainability perspective (Dedeurwaerdere, 2014; Holland, 1997), involves the preservation/conservation of some natural and human “entities”, in their materiality and their complexity. More clearly, it requires levels of preservation, determined scientifically and collectively, that constitute the framework within which the economy and accounting must operate. With this aim in mind, *a* natural capital and *a* human capital can be interpreted through an extension of Model 1, as “capital” things to be “refunded”/preserved over time. This way of doing represent the basis of CARE and of its associated R&D program. CARE is therefore an extension of the accounting system described in the first column of table 1, to “new” “things” (i.e. extra-financial “things”) to be preserved, and so, to “new” liabilities.

2.2.3 *Principles of CARE: Ecological/Sustainable Historical Cost Accounting*

The principles of CARE can be summarized as follows (**we only focus on natural issues**, even though the same reasoning is also applied for human/social issues (Rambaud & Richard, 2015b, 2017)):

- a) **conceptualizing natural “entities”¹⁹** (or at least part of them) used, directly or indirectly, by a company as **“capital”** in the sense defined in part 2.2.2, **so as “liabilities”, and not as resources/ assets**. It is therefore a question of treating them as real liabilities and not as mere means. Moving to a “liabilities” logic makes it possible to conceive the uses made of natural entities as a “loan”, a kind of “social and ecological debt”, which it is necessary to be able to “repay”: the preservation of natural entities used thus becomes a basis for the company's activity, in accordance with the ‘classic’ accounting logic of preservation of financial capital. Thus, **financial solvency** – the company's central performance, which measures its ability to meet its obligations, *i.e.* financial liabilities – **is complemented by “natural” solvency**. From this perspective, these capitals are “matters of concerns” and preserving/maintaining them requires the most accurate investigation into their nature, complexity and levels of conservation.
- b) **conceiving (natural) assets as the different types of uses of natural capitals**, in line with table 1 (first column). Again, this point is consistent with the classic accounting logic (model 1). This type of reporting makes it possible, as is currently the case in the balance sheet, to scrupulously detail the uses (*e. g.* repeated/fixed or current uses) of natural entities (capitals). For instance, in the case of a farm, a soil-as-ecosystem is a “natural capital”, whereas a “tree plantation” is a (fixed) “natural asset” and “wheat cultivation” is a (current) “natural asset”.
- c) therefore, **considering the income as a surplus beyond the preservation of all the different capitals used by a firm**. The accounting income and the revenues appear as a co-creation of value through the uses of all capitals, which collectively contributes to this creation of value.
- d) **evaluating capitals through the costs of their preservation over time**. More precisely, let us consider a natural capital (for instance, a river-as-ecosystem). The levels of its preservation are determined upstream, scientifically and collectively. Before its uses by a given company, processes of preservation (prevention or restoration - not compensation) must be planned over a relevant period of time to ensure the conservation of the considered capital. The (undiscounted) sum of the costs of these processes is the value of this capital at the beginning of its use: it is thus a budgeted value.

¹⁹ Biodiversity, soil-as-ecosystem, river-as-ecosystem, climate, etc.
Draft Report | September 2019

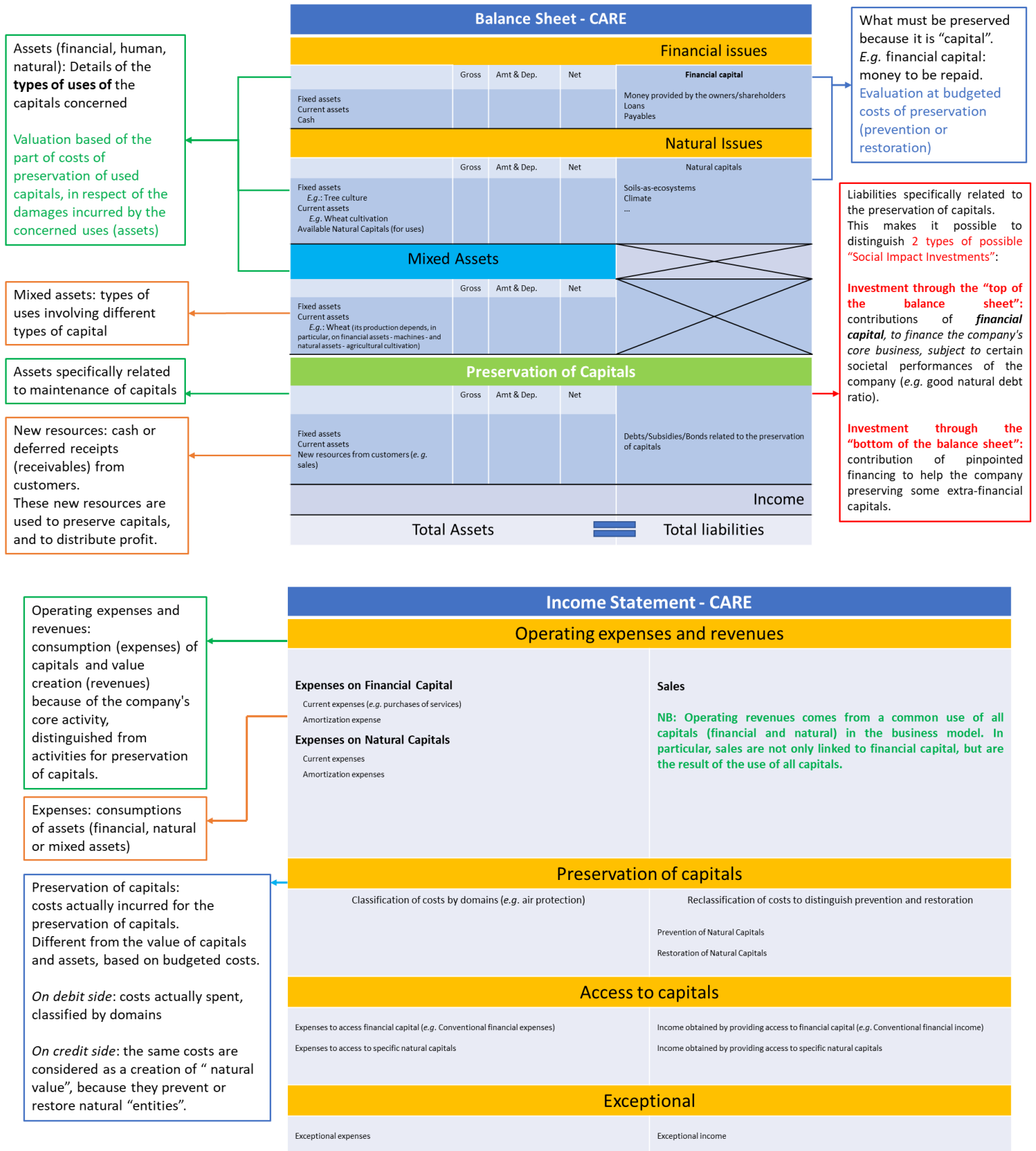
- e) **evaluating assets**, *i.e.* uses of given capitals, on the basis of **the share of the preservation costs** (see point d) of the used capitals, because of these uses. Thus, the more a given use degrades a given capital, the higher the value this use - and therefore of this asset - (*i.e.* the cost of preserving the capital, generated by this use) will be.

The recognition of an entity as a “capital”, and the operationalisation of this notion, in CARE is one of the central elements of the model. Three characteristics are necessary to determine if an entity can be a “capital”:

1. a concern about the preservation of the considered entity: an entity is a “capital” only if there is such a concern;
2. a clear description of the nature of this entity and of the ecological levels of its preservation (given in the annex of balance sheet and income statement). This nature and the level of preservation can be dynamic, *i.e.* can take into account the intrinsic evolution of the entity in time, independently of its exploitation. This description, explaining the nature of the existence of the concerned entity, makes it possible to establish and monitor its preservation;
3. at least one real process (a set of real actions) to preserve this entity, according to its nature described in point 2.

CARE therefore transforms social and natural issues in terms of entities to be preserved (through three questions, “**What do we care about?**” – point 1 –, “**what is the nature of the things, matters of concerns, and its levels of conservation?**” – point 2 – and “**how to concretely ensure this preservation, in relation to its conservation levels?**” – point 3), and so degraded during the business activity. This model is therefore based on a vision in terms of “stocks”, where flows are variations of stocks, and not in terms of “flows” – this perspective avoids in particular the **shifting baseline syndrome** (Pauly, 1995): for instance, the issue of climate change is not addressed in CARE directly through greenhouse gas emissions, but by integrating the issue of climate conservation (what we care about - point 1) and thus how to preserve it. Greenhouse gas emissions are therefore negative impact flows that generate a negative variation in the “stock” to be preserved, the climate. Concretely, in this case, Sciences-Based Targets, and their carbon budgets, are a way to tackle the problem of climate preservation. In CARE, schematically, climate change is addressed through the recognition of a “capital-climate”, a liability, whose value is based on the costs needed to respect carbon budgets (mainly prevention costs). The corresponding natural asset to this liability is the use of “climate”, *i.e.* the “emissions (GHG) storage”.

We give below the generic balance sheet and Income statement of CARE (only for financial and natural capitals) (Richard et al., 2018):



Assets (financial, human, natural): Details of the types of uses of the capitals concerned

Valuation based of the part of costs of preservation of used capitals, in respect of the damages incurred by the concerned uses (assets)

Mixed assets: types of uses involving different types of capital

Assets specifically related to maintenance of capitals

New resources: cash or deferred receipts (receivables) from customers. These new resources are used to preserve capitals, and to distribute profit.

What must be preserved because it is "capital". E.g. financial capital: money to be repaid. Evaluation at budgeted costs of preservation (prevention or restoration)

Liabilities specifically related to the preservation of capitals. This makes it possible to distinguish 2 types of possible "Social Impact Investments":

Investment through the "top of the balance sheet": contributions of financial capital, to finance the company's core business, subject to certain societal performances of the company (e.g. good natural debt ratio).

Investment through the "bottom of the balance sheet": contribution of pinpointed financing to help the company preserving some extra-financial capitals.

Operating expenses and revenues: consumption (expenses) of capitals and value creation (revenues) because of the company's core activity, distinguished from activities for preservation of capitals.

Expenses: consumptions of assets (financial, natural or mixed assets)

Preservation of capitals: costs actually incurred for the preservation of capitals. Different from the value of capitals and assets, based on budgeted costs.

On debit side: costs actually spent, classified by domains

On credit side: the same costs are considered as a creation of "natural value", because they prevent or restore natural "entities".

Figure 1: Balance Sheet and Income Statement - CARE

2.3 Position within (draft) spectrum

The CARE model includes both a balance sheet and income statement, which integrate natural and financial capital. The starting point of the CARE balance sheet is the 'liabilities', which are the obligation to the business to maintain (financial), natural and social capitals against some defined 'baseline'. This approach focuses on the business, its role and its guidance in the conservation and sustainable management of collectively and scientifically predetermined natural and social "capitals" (capital "entities") – rather than on a cost-benefit analysis of societal issues, to set the levels of preservation of natural and social entities – in a symmetrical manner to that used to protect financial capital.

Therefore, this method is a (symmetrically) aligned reporting of natural and financial capital.

3. Results

As explained before, most of the results of the on-going experiments of CARE cannot be reported to respect confidentiality. Here, we will simply draw from these real cases to provide schematic examples (all located in France), to deepen the understanding and application of the model.

3.1 Case study 1: Conception of "capital"

Company: Real estate company (global real estate operator of a French multinational) / experiment on one site.

During the experiment, the company expressed concern about water runoff from their buildings and concrete floors. In this way, it wanted to integrate the issue of water management into their CSR approach.

Processing in CARE:

It had to be determined whether there was a "capital" at stake and if so, what capital? Thus, behind the problem of water flows, a questioning had to define the entity (or entities) to which the company cared about and which was degraded to allow its activity. The answer was "the water cycle at the scale of the company's river basin". A capital "water cycle" has therefore been created. This allowed the company to be part of a more global reflection, at the level of the catchment area. The difficulties generated by this type of approach return:

- a certain lack of collective and scientific standards on the "things" to be preserved and the levels of preservation;
- a lack of appropriate management systems, focused on ecosystems, making it possible to manage "capital" on this scale (see part 4.3.2).

CARE can therefore contribute to tackle these issues and help/incite firms and public policies to design adapted instruments and information systems for ensuring preservation at different scales.

3.2 Case study 2: Integration of a natural capital in business model

Company: Farm / experiment on one site

The farm, with significant societal commitments, has a livestock activity. Animal welfare is a concern. We focus here on sheep.

Processing in CARE:

1) *Identification of the capital at stake.* The first hypothesis was to consider each sheep as a capital, a living being to be preserved in its quality of life. However, the fact that sheep are raised for their meat in particular has led to the abandonment of this idea. The object of concern is not each sheep, but the herd as a whole, which has led to the

recognition of a "capital-flock".

2) *Determination of the uses of this capital in the company's activity.* After study, four uses emerged: 'meat supply' (A1), 'wool supply' (A2), 'animation' (A3) (the farm being also an educational farm) and 'loan' (A4) to another company (of a part of the flock) to control grass by grazing. These four uses therefore constitute the four "natural assets" associated with the "capital-flock". This analysis leads to the direct integration into the company's business model of the flock that was actually absent from it: the four assets are understood as real sources of value creation. It is therefore possible to question the profitability of each use. In addition, the assets "meat supply" (A1) and "animation" (A3) are current assets: the use of capital in these two cases can be modified in the short term. The assets "wool supply" (A2) and "loan" (A4) are fixed assets: the loan is concluded over a period exceeding one year, while the fact of caring for a sheep herd physiologically obliges them to shear throughout their lives (it is not possible to question this use, unless the quality of life of the sheep is radically challenged).

3) *Determination of the value of the herd capital and related assets (general idea).* We start from the analysis of uses and their impact on the flock's quality of life. A1, A2 and A3 imply being able to feed and shelter the flock decently; these total feeding and sheltering costs (C) are allocated between the different uses (C1 for A1, C2 for A2 and C3 for A3 such that $C = C1 + C2 + C3$). A1 leads to specific costs (SC1) of stress reduction during transport to slaughter. A2 involves specific costs (SC2) to ensure a comfortable shearing. A3 involves specific costs (SC3) to protect animals from visitors. A4 involves specific preservation costs (SC4) determined by the company that employs and hosts a part of the flock. Broadly speaking, without taking into account temporality, the value of the "capital-flock" is equal, at the moment when it is just beginning to be used, to $C (= C1 + C2 + C3 + C4) + SC1 + SC2 + SC3 + SC4$. The value of A1 is $C1 + SC1$; that of A2, $C2 + SC2$; that of A3, $C3 + SC3$; that of A4, SC4. The principle of the double entry is thus respected.

We can notice that societal issues correspond to the liabilities-side (here, for instance, animal welfare) whereas business issues correspond to the assets-side (the way capitals are used in the business model to ensure value creation). The connection between these two issues is made possible by the double-entry principle.

NB: the flock also appears as an asset, as a use of financial capital, because part of it has been purchased. In this case, the value of this flock asset is the purchase cost. This asset does not correspond to a concern for the preservation of the flock beyond maintaining its productivity. The recognition of the flock as liability implies that it becomes more than a simple source of productivity whose conservation is subject to cost-benefit analysis (see part 2.2.1 and 2.2.2.) and that the farm's productivity comes mainly from the services provided by the flock, and not by the flock itself, allowing the value creation analysis to be refined.

3.3 Case study 3: Difference between evaluation of natural capital and costs with environmental impact / Natural debt ratio

Company: Creche / Experiment on one site

The company has HEQ (High Environmental Quality) buildings and wants to promote its low-carbon policy.

Processing in CARE:

1) The capital at stake here is "capital-climate". A first hypothesis was to treat the cost of building construction as part of the costs of preserving (preventing) "capital-climate". However, this is not really about prevention, but about reducing impact. More precisely, the construction of such a building serves as the company's core business, and makes it possible to reduce the impact on the climate, and therefore the costs necessary to preserve it²⁰. The valuation of capital in CARE is based on the costs necessary to prevent or restore a capital as a result of the activity, and does not include costs that reduce negative impacts on a capital.

Therefore, the construction of the building is a use of financial capital, aimed at reducing natural debt.

2) *Integrated analysis.* CARE makes an integrated analysis possible, i.e. a joint financial and non-financial analysis. One of the first workable ratios of such an integrated analysis is the **natural debt (or natural solvency) ratio** equal to

²⁰ It should be noted that a recommendation from the French accounting standard-setter (Recommendation n°2003-r02) indicates: "Expenditure which may have a positive impact on the environment, but which is primarily intended to satisfy other needs, such as improving profitability, hygiene and safety at work or ensuring the safe use of products manufactured by the company or production efficiency, must be excluded [from environmental expenditure]". Echoing this recommendation, the primary intention of the cost (profitability or environmental preservation) is thus decisive in classifying costs in CARE.

$R = \frac{CN}{CF + CN}$, where CN refers to all natural capitals and CF, all financial capital (CF+CN therefore constitutes the total value of liabilities, if human/social capitals are not taken into account).

The change from a normal building to an HEQ building leads to the following ratio evolution:

- CN decreases, as the impact of the new building reduces the necessary costs of preserving climate capital;
- CF increases because an HEQ building is more expensive (and therefore requires more financial capital) than a normal building.

Both these evolutions have the effect of reducing the natural debt ratio. An HEQ building is therefore classified in CARE as an asset on financial capital, with natural debt reduction.

3.4 Case study 4: Simplified example

01/01/N: creation of a farm: a farmer/owner buys a field for 1 000²¹ and a tractor for 500.

The field is not amortizable and the tractor is amortisable over 10 years.

Only one natural capital: capital-soil (no human capital to simplify).

Uses of this capital:

- Use of the soil (3/4) for a tree plantation (TP) (apples) (to simplify, here, over 3 years). This is a fixed (naturel) asset; indeed, at 01/01/Nn this tree plantation is fixed use of the soil for 3 years.
- Use of the soil (1/4) for wheat cultivation [WC]. This a current (natural) asset; indeed, at 01/01/N, wheat cultivation is a use of soil for only one year (possible change of use at the end of year N).

Maintenance costs (to simplify, only costs for restoration of the soil), based on actions of restoration:

- 1st year: 50 (because of the impact of WC on soil) and 200 (because of the impact of the TC on soil) → 250
- 2nd year: 50 (because of WC) and 200 (because of TP); the costs of restoration due to “Wheat Cultivation” are not included in the costs of maintenance of the “capital-soil” at 01/01/N, because WC is a current asset (cf. below)
- 3rd year: 50 (because of WC) and 50 (because of TP); same remark as above for maintenance costs due to WC.

Therefore, the costs of preservation of the “capital-soil” are equal to 500 = 250 + 50 + 50 = Value of “natural capital”.

Now the value of “Tree Plantation” (asset) is 450 (200 + 200 + 50), and the value of “Wheat Cultivation” (asset) is 50 (costs for the 1st year).

Balance Sheet at 01/01/N

Financial issues					
Uses of financial capital	Fixed assets		Financial capital	1,500	Financial capital
	Field*	1,000	(provided by the owner)		
	Tractor	500			
Natural issues					

²¹ Units of monney.
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Uses of natural capitals	Fixed assets		Soil	500	Natural capitals
	Tree plantation	450			
	Current assets				
	Wheat cultivation	50			

*:

“Field” (asset): recognition of the “soil” as a mere “field”, it means as a use of financial capital. The field is therefore a mere means, not a source of concern. Its value is its the purchase cost.

The “capital-soil” is not the field: it is a whole soil as ecosystem and a real matter of concern (Latour, 2009). It is assessed at its costs of maintenance (different from the purchase cost of the field).

The field and the capital-soil are the recognition of two different “realities” of the soil. In particular, as a field, a soil is only a productive “thing”, which is a centre of cost for financial capital; as a “capital-soil”, this soil is not an intrinsic productive thing, it is an element of “Commons” (Ostrom, 1991), whose protection is needed. It is these uses that generate resources for the company.

Let us suppose that the production of apples only implies the consumption of the “Tree plantation” asset, it means that we only need this specific use of the soil to generate apples (no machines, no labor for instance). Apples are therefore natural assets, i.e. uses of only natural capital.

Let us also assume that the production of wheat needs the consumption of the tractor and of the “Wheat cultivation” asset. Thus, wheat is a mixed asset, i.e. the use of financial capital (through the tractor) and natural capital (through the “capital-soil”).

½ of the whole production (apples and wheat) is sold during year N. And the sales for year N are assessed to 100.

Expenses for year N:

- For production of apples:
 - Amortisation of the “Tree plantation” asset: $150 (= 450/3)$
→ Cost of “apples” = 150
- For production of wheat:
 - Amortisation of the tractor: $50 (500/10)$
 - Consumption of the “wheat cultivation” current asset: 50
→ Cost of “Wheat” = $100 (50 + 50)$

Apples:

75 ($150/2$) sold and 75 hold in stock.

Wheat:

50 ($100/2$) sold and 50 hold in stock

→ **Costs of goods sold:** $125 (75 + 50)$

Income statement – Year N (before real restoration activities of the soil)

Operating expenses and revenues			
<i>Expenses on financial capital</i>		Sales	100
Amortization expense (tractor)	50	Changes in inventories of finished goods (apples and wheat)	125
<i>Expenses on natural capital</i>			
Current expense (WC)	50		
Amortization expense (TP)	150		

Balance Sheet at 31/12/N (before real restoration activities of the soil)

Financial issues					
Uses of financial capital	Fixed assets		Financial capital	1,500	Financial capital
	Field	1,000	(provided by the owner)		
	Tractor	500 50 450			
Natural issues					
Uses of natural capitals	Fixed assets		Soil	500	Natural capitals
	Tree plantation	450 150 300			
	Current assets				
	Wheat cultivation	0			
	Finished goods (apples)	75			
Mixed assets					
Uses of several capitals	Finished goods (wheat)	50			
Preservation of capitals					
	New resources (from clients)	100			
			Income	- 25	

Let us suppose that this farm decided to spend only:

- 25 (instead of 50 as planned) for costs of maintenance of the soil because of the wheat cultivation
- 120 (instead of 200) for costs of maintenance of the soil because of the tree plantation

→ Real costs of restoration: 145 (25+120)

Moreover, because the amount of sale is only 100, this firm obtained a public grant to help it to maintain the soil → Grant: 60.

Income statement – Year N (after real restoration activities of the soil)

Operating expenses and revenues			
<i>Expenses on financial capital</i>		Sales	100
Amortization expense (tractor)	50	Changes in inventories of finished goods (apples and wheat)	125
<i>Expenses on natural capital</i>			
Current expense (WC)	50		
Amortization expense (TP)	150		
Preservation of capitals			
Preservation of soil	145	Restoration (<i>ex post</i> preservation)	145

Balance Sheet at 31/12/N (after real restoration activities of the soil)

		Financial issues			
Uses of financial capital	Fixed assets			Financial capital	1,500
	Field	1,000		(provided by the owner)	
	Tractor	500 50 450			
		Natural issues			
Uses of natural capitals	Fixed assets			Soil	355 (= 500 – 145 [real restoration costs → “refunding” of the natural debt])
	Tree plantation	450 150 300			
	Current assets				
	Wheat cultivation	0			
	Finished goods (apples)	75			
		Mixed assets			
Uses of several capitals	Finished goods (wheat)	50			
		Preservation of capitals			
	New resources	15 (= 100 + 60 [grant] – 145 [real restoration costs])		Grant	60
				Income	- 25

We can note that the choice of actual restoration costs does not affect the income. This one is only based on the budgeted costs. The fact that the result is negative therefore means that the company does not generate enough turnover to cover the necessary restoration costs.

Actual expenditures on restoration costs, on the other hand, affect the level of environmental debt (natural capital), and, more importantly, the gap between environmental liabilities and assets. In absolute terms, a company that really spends nothing on preservation actions would ultimately have a fixed debt for a zero asset.

4. Methodology in practice

As explained, CARE makes it possible to produce fully integrated Balance Sheet and Income Statements, aligned with scientifically and collectively determined conservation (including IPCC and IPBES data) and strong sustainability issues. Under these conditions, CARE provides “integrated performances” (solvency, profitability, integrated leverage effects, etc.), which does not separate financial and non-financial aspects and which leads to an “integrated analysis” of companies. Moreover, combining CARE with an “ecosystem-centred accounting” model (see part 4.3.2) can allow to track and assess in ecological terms the specific contributions brought by a firm to environmental performances and regulatory targets at

the ecosystem scale. As a consequence, these “integrated analyses” can serve as a **basis for “integrated ratings” for a finance oriented towards strong sustainability with real impacts**; and CARE provides:

- a **framework for pinpointing green/sustainable investments** (see part 4.3.1), and
- a **coherent framework for integrating/accounting new sustainable financial products and aligning accounting with European taxonomy**.

Moreover, CARE reporting is directly compatible with the **Directive 2014/95/EU on disclosure of non-financial and diversity information**, and with the **classification of environmental protection activities (CEPA) of EUROSTAT**.

4.1 Innovation

In summary, CARE, and the associated research, R&D and experimentation programme, is based on the observation of a **convergence between**:

1. **the requirements of “strong sustainability”**, based on scientifically and collectively determined preservation/conservation needs and targets (*e.g.* respect of a 2°C trajectory for climate; conservation of certain levels of biodiversity; prevention of psycho-social risks, burn-out or musculoskeletal problems), and thus on the management of the costs necessary to ensure these preservations;
2. **the theoretical principles of traditional accounting, at historical cost**, whose purpose is to manage a capital “thing” to be preserved (financial capital, provided directly or indirectly by shareholders, banks, suppliers, etc.), through its uses (assets), its consumptions (expenses) and the revenues that can be realized accordingly.

CARE is therefore an **extension of Historical Cost Accounting, whose purpose is to manage several “capital” entities to be preserved, as defined by “strong sustainability” in association with financial capital, through their joint uses, common consumptions and the revenues that can be realised accordingly, and through the management of preservation and operating costs**.

Under these conditions, **all capitals in CARE are treated symmetrically**. In addition, the extra-financial and financial aspects are directly linked and associated to socio-environmental **scientific objectives**.

CARE articulates **in the business model**, through the “double entry” principle, **societal demands, represented on the liabilities side** (preservation of “capital” entities) and **organizational needs for profitability/operation, represented on the assets side**, designed as uses of the liabilities).

4.2 Application

CARE is **adaptable to any type of business sector**, as shown by its various past and present experiments. Furthermore, this model was directly thought to be **potentially standardisable**.

In practice, the application of CARE in a firm requires:

- its **active involvement** in:
 - a **discussion on – or even an evolution of – its business model**;
 - the **identification and problematization of ecological (and social) issues it needs to take into account and address**;
- an **articulation with context specific ecosystem management systems** (see part 4.3.2).

For instance, in the case of the “Collective Operation” (see part 1 and 2) in south of France, this implementation needs a one day theoretical training in this model and four one-day workshops, bringing together at least representatives of the

financial, accounting and CSR departments of the companies concerned, plus a specific work required from companies between each workshop. The planned implementation period in this case is approximately 9 months.

Under these conditions, CARE can also be used **to detect gaps in terms of data and concrete measures to ensure the “strong sustainability” of an organization.**

Now, for its whole standardisation, CARE requires **some evolution in the current legal structures – in terms of natural and social protections – in social and environmental data collection as well as in ecosystems management** (see part 4.3.2). Nevertheless, this type of evolution is **directly related to those observed in social and environmental law and in the current awareness on sustainability issues**: the French law on biodiversity, the case of Whanganui River in New Zealand²² (Sanders, 2017), or of Lake Erie in the US^{23,24}, to mention only a few examples, show a change of the law/mindset **towards a recognition of new obligations (liabilities) towards the environment.**

4.3 Other aspects

4.3.1 Other aspects of CARE

CARE allows an information gain on the costs associated with a sustainable business model, by distinguishing between preservation costs and operating costs, and by providing an appropriate classification to enrich:

- an **analysis of the company's internal performance**. For instance, is profitability at the expense of natural solvency? Are the uses of certain natural capitals really profitable in view of the revenues generated by these uses? (see Case 2 & Case 3 and one of the aims of the Collective Operation – see part 2);
- **dialogue with investors**. For instance, possibility of basing investment on “integrated performances”; as explained in fig. 1, possibility of distinguishing between financing needs of “core business” – case of a company with a sustainable activity and wanting to grow - and for transition assistance – case of a company with a business model not able to preserve certain capitals, and seeking financial contributions to make an ecological transition – (See Case 3). This aspect of CARE is the basis of discussions with the extra-financial commission of the French Society of Financial Analysts;
- **dialogue with customers**. In particular, a presentation of the costs associated with preserving capitals, properly structured, can generate a new consent to pay on the part of customers who want to have responsible purchases (as in the case of initiatives like “C’est qui le Patron”²⁵, where the presentation of certain social issues/costs²⁶ to consumers makes it possible to empower consumers and generate a new consent to pay higher prices). This is one the purposes of one of the experiments of CARE in distribution sector;
- **dialogue with public authorities**. CARE can be seen as an evolution of accounting system, capable of defining the basis for socio-environmental taxation and subsidy policies, adapted to the needs and specificities of companies;
- **understanding costs throughout the value chain**
- **the information and information system needs**, at the level of companies, sectors and public authorities, necessary to ensure the preservation of capitals and the management of preservation costs (see Case 1 and part 4.3.2).

In addition, CARE makes it possible to **align with national accounting** (research program of the “Ecological Accounting”

²² Declared as a legal person in 2017.

²³ <https://www.greatlakeslaw.org/blog/2019/02/lake-erie-bill-of-rights.html>

²⁴ Excerpt from the Lake Erie Bill of Rights: “Lake Erie, and the Lake Erie watershed, possess the right to exist, flourish, and naturally evolve. The Lake Erie Ecosystem shall include all natural water features, communities of organisms, soil as well as terrestrial and aquatic sub ecosystems that are part of Lake Erie and its watershed [...] All rights secured by this law are inherent, fundamental, and unalienable, and shall be self-executing and enforceable against both private and public actors. Further implementing legislation shall not be required for the City of Toledo, the residents of the City, or the ecosystems and natural communities protected by this law, to enforce all of the provisions of this law”.

²⁵ <https://lamarqueduconsommateur.com/>

²⁶ Structured in this way (for milk):

Grazing about 3 months a year: +0.01€ per carton of milk

Remuneration that allows the producer to pay himself properly: +0.08€

Etc.

chair): CARE modifies the added value to include preservation costs and allows a green GDP to be conceived as sums of Value Added redefined according to CARE.

4.3.2 *Articulating CARE with the “Accounting for the management of ecosystems” approach and model*

The CARE model is established primarily at the company level and proposes some transformations of firms’ financial accounting systems to integrate natural (and social) capitals. As we have seen, in CARE, a work of definition and description of natural entities with which the firm interacts has to be done at the level of the firm. However, this cannot suffice, since in most cases, the ecological quality of the natural capitals (biodiversity in a given area, a given river, soil, etc.) with which the firm interacts also depends on the interactions that other public or private organizations have with these natural entities and how they impact them. In other words, the company’s impacts on a given natural entity and the restoration actions it puts in place using the CARE model are only one part of the wider ecosystem conservation issue, that is also conditioned by other actors’ decisions and actions. Hence, the level of ecological impact due to the firm’s operations as well as the ecological performances of the conservation/restoration actions that the firm puts in place to repay its uses of a given natural capital are *relative*, and cannot be assessed independently from the assessment of other actors’ interactions with the ecosystem concerned (Feger & Mermet, 2017, 2019; Feger & Rambaud, 2019).

Hence, the company also has to get involved in a work of collective dialogue and negotiation that needs to be conducted at the ecosystem management scale regarding the definition of this natural entity; the ecological quality levels and thresholds that need to be maintained or reached collectively; and the individual actions that are relevant to be implemented by the firms and other actors. In case 1 for instance (see section 1.4), the real estate company meets difficulties to define its natural capital (*i.e.* water cycle at the scale of the river basin) due to a lack of clearer understanding of its specific place in the inter-organizational management of this specific river basin and a proper corresponding accounting of the ecological quality of this river basin’s water.

Specific accounting methods and innovations thus need to be developed and established at the ecosystem management scale to address these challenges and to be the support of such collective dialogue, action and accountabilities between actors (Feger et al., 2018). This is precisely what the “Accounting for the management of ecosystems” approach and model is designed for (Feger, 2016; Feger & Mermet, 2017, 2018, 2019). Three main aspects of this ecosystem-centred approach are summed up here (*ibid*):

- (a) There is first a need **to establish structured accounts of ecological results and performances obtained at the ecosystem level (in biophysical and ecological terms, based on conservation and environmental sciences) to serve as a collective reference to organizations involved in its collective management** (e.g. in case of study 1, accounts for water quality status and performance targets at the scale of the catchment on which the real estate company and other organizations operate). These accounts are shared collectively by the organizations that interact with the ecosystems and can be made public. They are defined both by environmental regulations and standards when they exist, and by the actors themselves when agreement is reached on given collective ecological targets. They can build on existing science-based indicators or ecological information systems already in place.
- (b) **Accounting for ecological impacts and contributions:** structured accounts need to be established to assess how specific activities and operations from different actors - including of course those of a given company implementing CARE - are impacting negatively the overall ecological quality of the ecosystem at hand (*e.g.* a given ecosystem functioning; a given species habitat, etc.). In addition, accounts need also be established to track and measure how the actions and efforts undertaken by the different organizations contribute to the sound management of the ecosystem (for a more detailed description of the possible structures of these accounts, see (Feger, 2016) and (Feger & Mermet, 2018)). These impacts and contribution accounts are shared by the different actors interacting with the ecosystem. They are necessary to define and discuss the respective and relative responsibilities of the different organizations concerned by the same natural capitals, and negotiate the relevant level of actions and efforts to be undertaken by each of them that would optimize the realization of the agreed

ecological targets.

- (c) The “accounting for the management of ecosystems” approach recognizes the **great diversity of ecosystem governance and management contexts and does not promote ready made solutions** (Feger et al., 2017; Feger, Mermet, McKenzie, & Vira, 2017; Mermet, 2018; Mermet, Homewood, Dobson, & Billé, 2013; Mermet, Laurans, & Leménager, 2014). Defining how the accounts can be used for negotiation and long-term management between actors requires in-depth analysis of the realities of the collective action dynamics, strategic interactions, and institutional structures at play in each given ecosystem. The main accounts (ecological results, impacts, contributions) however have the same general structure, which can allow for comparability between situations. These accounts can also be a basis for a structuration and pre-standardisation of ecological accounts at the ecosystem scale, across this diversity of contexts.

Ultimately, this ecosystem-centred approach needs to be articulated to the CARE model in order to progress towards a complete accounting system that goes from the internal management of a company to the collective and inter-organizational management of specific ecosystems (Feger & Mermet, 2019; Feger & Rambaud, 2019; Ionescu, 2016). This will allow individual firms involved in collective ecosystem management dynamics to assess whether and how their actions *really* contribute to obtaining ecological results, and to evaluate the costs necessary for providing these efforts.

5. Next steps

The “next steps” in the R&D programme associated to CARE is structured around the following points:

- an **extension of the organisations involved in this project (in different countries)**, in terms of consulting firms²⁷, of companies ready to test the model²⁸, of public institutions interested in supporting this project, of academic organisation wishing to collaborate on this subject, *etc.*;
- the **continuation and increase of experiments**;
- the continuation of an **in-depth study on natural (and human) capitals**, to **understand their nature and how to preserve them**, and thus **better measure their preservation costs** (see following point);
- the efforts of **articulation with ecosystem-centred accounting**, on theoretical, conceptual and practical level;
- the practical and theoretical development of the **different aspects mentioned in the part “Other aspects of CARE”** (see part 4.3);
- its **implication on business models**;
- a **specific work on accounting standardisation**, that would enable the model to become operational at European level;
- its inclusion in the **evolution of accounting and commercial law**²⁹.

²⁷ For example, a French CSR consulting firm is currently working on the feasibility of developing CARE within the framework of public accounting.

²⁸ For instance, CARE is included in a very recently awarded project (named Sesame) of the French program “Territoires d’Innovation”. This programme is supported by the French State within the framework of the “Grand Investment Plan” to develop innovations on a large scale in response to the transformation needs expressed by the actors in the winning territories. The Sesame project is located in the Paris region and focuses on agro-ecology and the ecological and energy transition (in the context of farms and the redevelopment of the territory concerned). CARE will be tested as an accounting model to support this ecological transition, in partnership with “Fermes d’Avenir” and researchers of the chair “Ecological Accounting” (see part 2).

²⁹ CARE is at the heart of current discussions on the possible tabling of a future law on the evolution of French extra-financial reporting.

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