

THE SUSTAINABILITY OF “SUSTAINABILITY” — A STUDY INTO THE CONCEPTUAL FOUNDATIONS OF THE NOTION OF “SUSTAINABILITY”

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The new challenge for organisations is to deal with the complex issue of sustainability. However, the confusion surrounding “sustainability” hinders its implementation. This article formulates a framework consisting of three aspects to analyse the conceptual developments that underlie “sustainability”: the artefact (“what”), goal orientation (“relative versus absolute”) and (behavioural) interaction (“static versus dynamic”). The study of conceptual foundations underpins the framework. Contributions in both the theoretical (definitions) and the practical (indicators) spheres are analysed. The discussion about sustainability takes place in firms. Therefore, organisational developments are used as a reference timeline. Based on observations and analyses, this article suggests a new course for the sustainability discussion and its implications for the organisational context: a knowledge approach focussing on transparency and dialogue. This also implies that the emphasis in the sustainability discussion is changing from a merely environmental to an organisational and societal perspective.

Keywords: Sustainability; conceptual development; conceptual foundation; organisation; sustainability indicators; knowledge management.

Introduction

Sustainability is a complex and confusing concept. Our research on sustainable innovation (Jorna *et al.*, 2004) started 3 years ago and we expected to find one or two already existing definitions or operationalisations that we could use. This was not the case. About 50 definitions and circumscriptions of sustainability exist; the amount of operationalisations in relation to shareholders and stock exchange

markets is much larger. A sample card of these definitions is discussed later in this paper. Additionally, it appeared that many definitions could not easily be compared. We concluded that a deeper digging into the concept of sustainability was necessary.

We also believed that an intelligent selection of the definitions and operationalisations of sustainability was used as a start, in order to continue our empirical case study research within 13 organisations (Jorna *et al.*, 2004). This assumption was also wrong. An intelligent selection was not enough, because it could easily lead to biases or prejudices. Ecologists, economists, sociologists and biologists, to name but a few disciplines working with sustainability, all had their own favourite perspectives. However, mostly they did not take into account other perspectives. Therefore, we had to progress towards conceptual clarity by looking at sustainability in a different way. The different road we took turned out to be a research project on its own. Instead of integrating or selecting sustainability notions, we treated “sustainability” as a concept that could not be rigidly defined. This means that the essence of “sustainability” cannot easily be determined. We hypothesised that the concept could have developed over time under the influence of societal, cultural and organisational debates and discussions. Therefore, the dynamics of the concept, its direction and its evolvement is the topic of this investigation.

The analysis and search for developments of notions such as “sustainability” is called the study of conceptual foundations. It is part of the analytic tradition within philosophy and logic that tries to unravel and formulate the moves and counter-moves that various researchers made when using basic concepts. Examples of this research tradition can be found in the work of Barth (1971) on “The Article”, Lovejoy (1964) on the notion of “Chain of Being” or Passmore (1970) on the notion of “Perfectibility” or the notion of “Responsibility for Nature” (Passmore, 1970; 1980).

The study of conceptual foundations uses analytic, semantic and sometimes logical means to look not only at a concept itself, but also at its development, its neighbouring concepts and the moves and counter-moves in the interpretation of the concept that have been made during a certain period. This does not imply that the development of a concept is itself logically predetermined and just unfolds, on the contrary. Very often, the study of conceptual foundations is a matter of re-interpretation, reconstruction and semantic analysis. In this article, the notion of sustainability is investigated in a similar way as Lovejoy or Passmore did for other notions. We try to bring to the surface conceptual developments that are expected to underlie the sustainability discussion and we try to distil a (future) course of the discussion.

Central in this article is our astonishment that so many theoretical and practical approaches regarding sustainability exist. Negatively formulated, because of the large quantity and diversity of approaches, sustainability has been identified

as a concept that lacks consensus and direction (among others Phillis and Andriantiatsaholiniaina, 2001). Although the lacking consensus and absent direction is not questioned — it is there — we want to explore the concept of sustainability in depth by analysing and categorising its various approaches. We take a managerial and organisational perspective, because nowadays many firms and organisations are trying to implement “something sustainable”.

To illustrate what a lacking consensus and an absent direction means, we give the definitions of Coomer’s sustainable society and of the World Commission on Environment and Development’s (WCED) sustainable development. Coomer says: “[The] sustainable society is one that lives within the self-perpetuating limits of its environment” ((Coomer, 1979) as cited in Pezzey (1992)). The WCED formulated: “[Sustainable development] is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). Coomer’s (1979) sustainable society focuses on the relationship of a society with its direct environment, whereas the WCED (1987) emphasises the inter-generational factor of sustainability. Although both use the concept of sustainability, their completions are different in content and focus. Many other examples of approaches to sustainability, all highlighting different issues and all applying the concept in different contexts will be discussed in later sections.

To investigate the development of the notion of sustainability a framework is formulated that can be used to determine various properties of the concept of sustainability that is used. The most important property is the determination of “what” (the artefact) is sustainable. Secondly, the issue of sustainability often implies talking about change, innovation or adjustment. There are at least two ways of dealing with change or innovation. Starting with an idealised end state or starting from now and here: the initial state. The former is called an absolute perspective on sustainability, the latter a relative perspective. We call this aspect of the framework goal-orientation. Thirdly, saying that something is sustainable means that there is a relationship of “something” with a surrounding or “supporting” environment. In this relationship, the perspective can be static or dynamic. We call this the aspect of interaction. The framework is discussed in detail in the next section.

The three aspects of artefact, goal orientation and interaction make up the framework to investigate the development of the concept of sustainability. The main inspiration for our work on sustainable innovation and sustainability itself came from the increasing debates and discussions within companies and firms about how to deal with issues of sustainability, not only from an environmental but also from a social perspective. This implies that if companies want to do something about or with sustainability, they have to know what sustainable means. Because of this managerial, organisational perspective, we looked for overviews concerning the development of firms and organisations.

Interesting work has been done by Bolwijn and Kumpe (1990) (discussed later). They covered the same time line and analysed the developments of firms. In addition, because firms and organisations more and more use indicator lists, we started with firms, and not with institutions or public organisations. We do not say that important developments have not taken place in institutions, societies and culture. A complicating factor of looking at institutions and societies is that their pace of development is much slower.

There is also a caveat in using Bolwijn and Kumpe. From the reference to Bolwijn and Kumpe (1990) it does not follow that a causal relationship exists between the development of “sustainability” and organisational development. To determine such causality is nearly impossible given the multi-layered and multi-directional relations between the complex set of variables. However, looking at co-variation may be very informative in an exploratory way.

The structure of the article is as follows. In the next section, the framework with the aspects of entity, goal orientation and interaction is explained. Then, the concurring developments in firms and organisations are described. In subsequent sections, the developments in the definitions of the concept of sustainability are described along with a discussion for indicator lists. Finally, conclusions are given and possible future directions are sketched.

Conceptual Framework for Development Analysis

The sustainability concept

The term sustainability was introduced to provide a means for handling the type of problems concerning the deteriorating relationship between our global ecology and an ongoing economic development (Chiesa *et al.*, 1999). Sustainability pointed out ways in which an economic development could be realised, while taking supposed environmental limits into consideration (Meadows *et al.*, 1972). As stated earlier “sustainability” is ill-defined, not defined or contradictorily defined (Phillis and Andriantiatsaholiniaina, 2001).

When the term sustainability is used, the first question that comes to mind is “sustainability of what?” Usually, sustainability is treated as a property that is an attribute of some artefact, in line with the way sustainability was applied to pinpoint the relationship between global ecology and economic development (Meadows *et al.*, 1972). In the case of Meadows *et al.*, economic development is considered an artefact that has a relation with the environment. The property of sustainability is used to express the relationship between this artefact and the environment in which it exists, and with which it interacts. Therefore, if an economic system is sustainable it means that it does not exhaust the surrounding environment. Formulated

more generally, sustainability expresses the relationship between an artefact and its environment concerning particular behavioural aspects.

Semantically, sustainability indicates a relationship between an (sustainable) artefact and its environment that exists indefinitely. In other words, sustainability refers to an equilibrium between an artefact and its supporting environment, where they interact with each other without mutual detrimental effects. Sustainability explicitly refers to this equilibrium.

If a quasi-formal perspective is taken, in which we try to clarify the logical behaviour of the notion, “sustainability” can be viewed as a predicate. We use a more mundane example to explain this analysis. In logical terms “to marry” is a two-place predicate (operator), taking two arguments (slots). “To marry” is also irreflexive (one can never be married to oneself), symmetrical (if one is married with another, the other is married to you) and intransitive (if one is married to another, that other cannot be married to someone else). The same analysis can be done for the logical behaviour of “sustainable”. If we say, “this car is sustainable”, do we mean that “sustainable” as a predicate has one or two arguments? In our opinion, sustainability should be formulated as a two-place predicate or a dyadic operator. This implies that we have to say, “This car is sustainable in relation to X”. In contrast, the concept of endurance (very much resembling sustainable) is, in logical terms, a one-place predicate or monadic operator. Endurance will only tell something about the inherent potential of an artefact to withstand hostile, external influences. That is to say, the endurance of an athlete refers to the capability of the athlete to withstand the hardship of a marathon. Endurance only indicates the inherent capability of the athlete to withstand this hardship, but does not state anything about the environment in which the athlete operates. This quasi-formal analysis already makes clear that “endurance” and “sustainable” are not the same. Besides that “sustainable” is a two-place predicate, it is also irreflexive (something is never sustainable to its self), non-symmetrical (if there is a sustainable interaction of A in relation to B, it is not always the case that the converse sustainable relation holds) and non-transitive (if A is sustainable in relation to B and B to C, then sometimes A is sustainable in relation to C and sometimes it is not). The latter indeterminacy depends on the system borders and system partitioning.

From an analytic perspective, it is also necessary to be more precise about the characteristics of the artefact. If sustainable is a two-place predicate, in which the balance between an artefact and its environment is important, we have to know more about the nature of the sustainability equilibrium. It is also necessary, when sustainability issues are started in organisations, to have an indication of what can and cannot be regarded as sustainable.

Artificial systems

Sustainability specifically concerns artificial or human-made systems. These systems are generally described in terms of function, objective and adaptation, and are able to imitate natural systems without being natural themselves (Simon, 1969). Simon defined an artefact as the boundary between an internal and external environment. His concept of artefact refers to any construct that is human made, taking many different forms and lying somewhere on the continuum between concrete and abstract. In contrast to artificial systems, biological systems are considered inherently sustainable, because when the equilibrium between a biological system and its environment is disturbed, these systems behave in such a manner that the equilibrium is restored. Unless explicitly programmed, artificial systems lack such equilibrium-restoring capabilities, which can cause them to stay in a non-sustainable situation until they collapse.

To explain what is meant with the equilibrium-restoring capabilities of biological systems, we use the biological concept of ecosystem. An ecosystem consists of living organisms and their environment, including rocks, soil and water. A food web connects all living organisms within an ecosystem, based upon their function. Producers transform non-living material into organic material. Primary consumers eat producers. They are subsequently eaten by secondary consumers. Reducers transform dead organic material into non-living material and so the cycle of the ecosystem is closed. The relationships between predators and prey within an ecosystem are described, for example, by mathematical equations of Volterra (1959). These equations indicate that over-consumption by one species within an ecosystem affects the whole food chain, and therefore the existence of the species.

Artificial systems are different, also in complexity, reaching from very simple to very complex. Simple artificial systems have a simple structure, which makes their behaviour predictable. In contrast, complex artificial systems behave unpredictably. For example, a car as a transportation unit is a reasonably simple artificial system with predictable behaviour. A society in which all individuals over 18 years of age drive a car is of a different complexity. In this case, the simple units make an extremely complex traffic system. Especially when issues such as greenhouse effects, air pollution, diminishing oil supplies or traffic problems come into play, the increase in complexity complicates the possibility to estimate how such a “system” will develop.

Natural systems, of which biological systems are a subset, limit our possibilities to construct artificial systems. Their sources provide us with the raw materials used for building artificial systems and the energy that makes these artificial systems function. Renewable sources provide us with an unlimited supply of raw materials and energy. In contrast, non-renewable sources can only provide us with raw

materials or energy for a limited amount of time. Natural systems’ sinks absorb the waste our artificial systems generate. Sustainability concerns the cycle from source, through artificial system, to sink.

Sustainability is important for artificial systems, because the cycle that is part of an artificial system is often left out of consideration. The neglect of aspects of sustainability especially concerns complex artificial or social systems, largely because these systems cannot easily be designed. Social systems often autonomously develop in a direction that mostly is unknown beforehand. However, because knowledge determines individual behaviour and because social systems consist of individuals, knowledge can influence a social system’s sustainability. We return to this discussion of the relation between knowledge and sustainability after we have explained the conceptual framework to analyse the various definitions and indicator lists of sustainability.

Three aspects of sustainability

The framework consists of three aspects: kind of artefact, goal orientation, which is to say whether an absolute or relative perspective is used, and (behavioural) interaction, meaning whether sustainability is conceived of as static or dynamic.

Artefact

The identification of the focal artefact concerns the tangibility of the artefact to which sustainability is attributed. Concrete artefacts are labelled entities and abstract artefacts constructs. In considering artefacts, we can conceptualise the sustainability of a car. The car is a concrete artefact to which the property of sustainability can be attributed. Without discussing whether the car in fact complies with a general idea of sustainability — e.g., the energy source gasoline can be replaced by hydrogen cells — the attribution of the sustainability property is possible and subsequently has meaning. The attribution of sustainability to other tangible artefacts can be done in a similar way.

Another example is sustainable health care. This brings along the attribution of a property to a construct. It can be easily understood that the complexity of the health care system is much bigger than that of one car, and that attributes and aspects at different levels of aggregation are important for health care, such as mortality rates or waiting lists. The distinction between entity and construct is the first aspect on the horizontal axis (columns) of the matrix constructed. Linking sustainability to constructs enables one to abstract from reality, and to identify relationships that are more complex and often not directly visible.

Goal orientation: absolute–relative

The second aspect of the framework concerns the point of reference that is used in determining whether an artefact is sustainable. We distinguish absolute and relative lines of reasoning underlying the specification of what is to be considered sustainable. The distinction between the two is the used point of reference that discriminates between what is and what is not sustainable.

The absolute approach to sustainability identifies a continuum with two extremes: non-sustainable and sustainable. The leading extreme point on this continuum is “sustainable” in its idealised form. The underlying idea is that some form of “(real) sustainable” exists that is leading when a change from the here and now to the ultimate form of “sustainable” is necessary. The problem, is of course, that nobody knows what the real form of the ultimate sustainable is. However, that often does not prevent people from taking this ultimate form as a guiding principle.

In his treatment and analysis of the existence of “ultimate goods” that are omnipresent in Western thinking from the “ultimate classless society”, to the “ideal market” and the “real rationality”, Beth (1959) has named this principle: “Aristotle’s principle of the Absolute”. Beth reasons as follows. Someone working with the notion of an “absolute” starts with a statement that every activity aims at accomplishing a result that is considered good (or Good); reversely some good (or Good) exists that everything aims at. Three different objectives (Goods) exist: activities that aim at serving a direct purpose; activities that serve a purpose that is subordinate to a higher, probably unconscious, purpose; and the possibility that a higher (unconscious) purpose is again subordinate to an even higher (unconscious) purpose. This last step is expressed by the statement that “the aim of all our activities must be the Good and even the Supreme Good” (Beth, 1959). Beth presents this idea of the existence of a Good and a Supreme Good to accumulate infinitely, and if we apply it to sustainability, the continuum from non-sustainable to sustainable will be infinitely long.

“Aristotle’s principle of the Absolute” (Beth, 1959) defines a state or existing purpose that is the ultimate goal, achievable by human activity. If this idea of an existing, ultimate good is abandoned, the idea of an ultimate goal that needs to be strived for no longer holds. Instead, a more pragmatic perspective is applicable, leading to — what we call — a relative way of appreciating sustainability. A relative approach starts with the present state of affairs and identifies existing problems, which people subsequently attempt to solve. Improvements take place incrementally within this relative approach to sustainability. It is an approach of small steps instead of a grand design. In contrast to the absolute approach, the focus of this relative approach is not the good, but the less worse or the better.

Making the distinction between the absolute and the relative very much resembles the distinction between the utopian and the pragmatist in action. The utopian

will always dedicate his efforts to his struggle for the ultimate situation: utopia. The pragmatist on the other hand will focus on the problems at hand and try to solve those, in order to make the world a little bit better. This absolute or relative goal orientation with respect to sustainability forms the second aspect of the horizontal axis of our matrix (columns).

Behavioural interaction: static–dynamic

The third aspect concerning the attribution of sustainability to an artefact is whether the dynamics of the artefact and the environment is accounted for. This aspect originates from the idea that artefacts and their environments experience changes of their component parts and internal structure, caused by exogenous forces resulting from their interactions and endogenous forces originating from within. The attribution of sustainability to an artefact can either account for changes of both artefact and environment or assume these to remain unchanged.

In a static perspective, the artefact is dynamic, whereas the environment is only static. Within this approach, the relation between the artefact and its environment remains unchanged. However, it is possible that the component parts and the internal structure of the artefact change. The only element of interest concerning the sustainability equilibrium between the artefact and its environment is the magnitude of the interaction between artefact and environment. Obeying the limitations of its environment ensures the artefact’s sustainability, which from the static perspective is everlasting by definition. An example of the neglecting aspect of a changing context is asbestos. In the 1960s, the use of asbestos was regarded as sustainable due to its fireproof characteristics. Nowadays, the dangers involved in processing asbestos refrains anyone from using it (see, for instance, McElroy, 2002). In general, ignorance of possible dangers of technologies, which is common in the static perspective, is dangerous (Wynne, 1992) and unsustainable.

From a dynamic perspective, exogenous and endogenous forces impose both artefact and environment to change, thereby influencing the sustainability equilibrium. In order to reach sustainability, the artefact tracks changes in its environment continuously and adapts to these changes to keep the equilibrium intact. Organisations adapt to their organisational environments continuously; for the organisation to ensure its sustainability, adaptation to these exogenous forces is necessary. Next to these exogenous forces, organisations are subject to endogenous forces. These endogenous forces can be an important cause for the unsustainability of the organisation. Both exogenous and endogenous forces exist, requiring the organisation to adapt continuously in order to be sustainable.

The static and dynamic attitude towards sustainability constitutes the third and final aspect of the horizontal axis of our matrix (columns). This aspect allows the

Table 1. Horizontal axis of the framework for detecting developments in sustainability.

Author	Year of Publication	Entity/Construct	Absolute/Relative	Static/Dynamic
Will be expanded in Table 4 and Table 5				

identification of whether an attribution of sustainability to an artefact incorporates the underlying dynamics of the artefact and its environment (see Table 1).

In this article, we expect that the attribution of sustainability to kinds of artefacts shows conceptual developments in the period from the 1960s unto the 2000s concerning the three aspects that constitute the horizontal axis of our matrix. The horizontal axis enables the categorisation of attributions of sustainability and the detection of possible conceptual developments.

As we earlier indicated, the domain of analysis concerns firms and organisations, because sustainability discussions grew stronger within organisations in the last 10 years. Analyses of developments in other areas than business can be found in policy making (Webster, 2004) and ego development in women (John *et al.*, 1998). We used Bolwijn and Kumpe's (1990) analysis of business or firm development parallel to our sustainability analysis.

Developments of Firms and Organisation

In the field of management studies, development of firms within the period from 1960 until 2000 have partly been classified by Bolwijn and Kumpe (1990). They propose a model that displays developments of markets, technology and competition among firms concerning the period from the 1960s up to and including the 1990s. The core of their classification consists of what they identify as the ideal types of efficient, quality, flexible and innovative firm archetypes, referring, respectively, to the 1960s, 1970s, 1980s, and 1990s (see Table 2). Instead of the term ideal type, we use the more neutral term "firm role models", emphasising that firm types do not prescribe the way a firm should be, but provide an image that firms are willing to imitate. On top of this, we propose an extension to Bolwijn and Kumpe's classification to extrapolate our findings to possibly new directions of and within firms.

The role model of the efficient firm characterises firms of the 1960s. It was a period in which the market required firms to produce low-cost products. Emphasis was on hierarchy and specialisation. The quality firm role model refers to the 1970s,

Table 2. Suggested extension of Bolwijn and Kumpe’s classification into the 2000s (italics represent the original table drawn up by Bolwijn and Kumpe, 1990).

Period	Market Requirements	Performance Criteria	Firm (Role Model)	Firm Characteristics	Organisational Focus
1960s	Price	Efficiency	Efficient firm	Specialisation and hierarchisation	Structure
1970s	Price, quality	Efficiency + quality	Quality firm	Communication and co-operation	Culture
1980s	Price, quality, product line	Efficiency + quality + flexibility	Flexible firm	Integration and decentralisation	Structure
1990s	Price, quality, product line, uniqueness	Efficiency + quality + flexibility + innovativeness + ability	Innovative firm	participation and democratisation	Culture
2000s	Price, quality, product line, uniqueness, customer involvement and openness	Efficiency + quality + flexibility + innovative ability + dialogue ability	Knowledge firm	Dialogue and transparency	Structure

when quality was the main driver. The emphasis was on the aspects of communication and co-operation. In the period of the flexible firm role model (1980s) the market demanded firms to offer a broad line of products. Flexibility induced a focus on integration and decentralisation. The 1990s was the decade of the innovative firm. Placing new, unique products on the market in shorter times was expected to become the new performance criterion for firms. The organisation's focus of the innovative firm is on participation and democratisation (Bolwijn and Kumpe, 1990).

Bolwijn and Kumpe (1990) formulated their classification as an evolutionary process, where every role model builds upon its predecessor's achievements. During a period, firms develop characteristics that provide them with essential capabilities to address the market requirements of the next period (Bolwijn and Kumpe, 1990). The basis of their classification consists of observed developments in relation to market, technology and competition, in which two trends were noticed. The first trend they find is that every next archetype needs to address a more fragmented market than the preceding one. Secondly, they observe that every next archetype takes the opposite stand on the continuum between a structural focus and a cultural focus of the organisation. Structural means that (re)design and (re)construction of functional units and its processes in an organisation are more important. Cultural means that habits and implicit knowledge in an organisation are more important.

Because Bolwijn and Kumpe's model stops with the classification in 1990s, we propose an extension of the classification with the notion of the "knowledge" firm (Grant, 1996), indicating that the 2000s can be characterised by transparency (Burke and Logsdon, 1996) and dialogue (Chiesa *et al.*, 1999). This extension builds upon the underlying developments of an ever-increasing market fragmentation. From the firm's point of view, an increasing market fragmentation implies serving more individual and divergent markets, focusing on meeting customers' personal expectations. From a customer's perspective, one could argue that customers grow more mature, increasingly demanding an individual treatment and insight into organisation's production or service processes. Therefore, the new market requirement is postulated as customer involvement and openness to the outside world; an organisation needs customer input to comply with individual demands and wishes, and has to be open to customers concerning products and used processes to be accepted in the market.

The time line, extended with the classification of Bolwijn and Kumpe, forms the vertical axis of the matrix (see Table 2). As indicated, this timeline is used as a parallel line of the development of firms. With the formulation of the reference timeline, constituting the vertical axis of our matrix, and the previously specified horizontal axis, reflecting the three different aspects of sustainability, the entire matrix can be constructed. This matrix enables the classification of different contributions to the

Table 3. Framework for detecting developments in sustainability.

Decade	Role Model Firm Type	Author	Year of Publication	Entity/ Construct	Absolute/ Relative	Static/ Dynamic
1960s	Efficient firm					
1970s	Quality firm					
1980s	Flexible firm					
1990s	Innovative firm					
2000s	Knowledge firm					

Will be expanded in Table 4 and Table 5

sustainability discussion and determination of possible developments that occurred over time.

A specific analysis of the developments in the notion of sustainability is now possible. A matrix is used to display conceptual developments within the sustainability discussion with regards to the identified aspects and the estimation in which direction the discussion of sustainability is expected to develop (see Table 3).

In discussing the theoretical (definitions) and practical (indicator lists) applications of sustainability within the developed framework, these applications are unravelled with regard to the three aspects. This is depicted in the horizontal axis of the matrix concerning the aspects focal artefact (entity–construct), goal orientation (absolute–relative) and behavioural interaction (static–dynamic). The vertical axis concerns the progress of time. Our objective is to estimate in which direction the sustainability discussion is heading concerning the identified aspects. To detect these trends and to estimate in which direction the different theoretical and practical applications of sustainability are developing, the vertical axis of our matrix is equipped with the existing categorisation of market and firm developments by Bolwijn and Kumpe (1990).

The Theoretical Contributions to Sustainability

Definitions of sustainability

Concerning theoretical contributions to the sustainability discussion, this article focuses upon the definitions. On the one hand, definitions form the foundation of reasoning. On the other, definitions can seriously limit its scope. Definitions of sustainability specify the relationship of some artefact with its environment, and state whether this relationship is sustainable.

Sustainability was a point of discussion in relation to economic and social issues, at the International Conference for Rational Use and Conservation of the Biosphere, organised by the United Nations Educational, Scientific, and Cultural Organisation

(UNESCO) in 1968, without explicitly stating what was understood by the term (USDA, 2003). Later, various authors attributed different meanings to the concept of sustainability (see Pezzey, 1992, for an overview).

Pirages (1977) and Coomer (1979) provide their perceptions of a sustainable society. Pirages (1977) states that sustainable economic growth “means economic growth that can be supported by physical and social environments in the foreseeable future”. Because he disregards possible changes of the physical and social environments, we see Pirages’ contribution to the sustainability discussion as static. Next to this, Pirages implies that “an ideal sustainable society would be one in which all energy would be derived from current solar income and all non-renewable resources would be recycled”, with which he pursues an absolute view of sustainability. Coomer’s (1979) sustainable society is a society “that lives within the self-perpetuating limits of its environment”, also disregarding possible, structural changes of the environment. Because Coomer attributes explicit limits to a sustainable society that is aimed at, his approach is labelled absolute.

Starting its work in 1983, the World Commission on Environment and Development (WCED) presented its report “Our Common Future” in 1987, discussing the ongoing exhaustion of our planet’s resources, caused by increasing economic growth and an unequal, worldwide distribution of wealth (WCED, 1987). As a solution to the identified problems, the commission stated that society should pursue sustainable development, which is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). With this perception of a sustainable development, the WCED takes a static perspective and an absolute appreciation towards sustainability. The WCED takes needs of all future generations as the point of reference, and assumes that underlying social and environmental structures remain constant with the progression of time. Similar absolute, static approaches stem from Meadows *et al.* (1992), Pezzey (1992), Hart (1995), Elkington (1999), Allen (1980), Porritt (1984), Talbot (1984), Tietenberg (1984), Clark (1986), Daly (1986) and Brown *et al.* (1987).

Taking a relative approach towards sustainability, Solow (1986) specifies that sustainability means that society maintains “an appropriately defined stock of capital — including the initial endowment of resources” intact and that its “consumption can be interpreted as the interest on that patrimony”. With his contribution, Solow takes a relative standpoint; living on the interest of reproducible capital takes the present situation as the point of reference. Because he does not address changes of the considered artefact and its appropriate environment, Solow’s contribution is categorised as static.

Similar relative, static contributions to the sustainability discussion stem from Goodland and Ledec (1987), Markandya and Pearce (1988), Pearce *et al.* (1988), Turner (1988) and Pronk and Haq (1992). Goodland and Ledec (1987) treat

sustainable development as a "pattern of social and structural economic transformations which optimises the economic and societal benefits available in the present, without jeopardising the likely potential for similar benefits in the future" (cited in Pezzey, 1992). Markandya and Pearce (1988) claim that sustainability "ought to mean that a given stock of resources... should not decline" (cited in Pezzey, 1992). Pearce *et al.* (1988) formalise sustainable development as "a vector of desirable social objectives", that "increases monotonically over time" (cited in Pezzey, 1992). According to Turner, an optimal sustainable growth policy "would seek to maintain an 'acceptable' rate of growth in per-capita real incomes without depleting the national capital asset stock or the natural environmental asset stock" (Turner, 1988). Pronk and Haq (1992) indicate that sustainable development means that "current consumption cannot be financed for long by incurring economic debts that others must repay" and that "sufficient investment must be made in the education and health of today's population so as not to create a social debt for future generations". The authors state the directions in which society can develop, relative to the present situation. They, however, all assume economic, environmental and social structures to remain unchanged, holding on to the static perspective.

In 1986, Repetto (1985) stated that "our economic systems should be managed so that we live off the dividend of our resources, maintaining and improving the asset base" (cited in Pezzey, 1992), implying a relative approach. On top of this relative approach, he explicitly states, "this does not mean that sustainable development demands the preservation of the current stock of natural resources or any particular mix of human, physical, and natural assets. As development proceeds, the composition of the underlying asset base changes" (cited in Pezzey, 1992). Because Repetto considers "the underlying asset base" to change, his contribution is classified dynamic.

Although Repetto already presented his ideas on sustainability in 1986, they were adopted broadly years later. Similar dynamic, relative contributions to the sustainability discussion originate from Meppem and Gill (1998), Tietenberg (2000) and McElroy (2003). According to Meppen and Gill (1998) "sustainability describes a state that is in transition continually", implying a dynamic approach. On top of that, they specify that "the object of sustainability is not to win or lose and the intention is not to arrive at a particular point", with which they clearly take a relative point of view. Tietenberg (2000) defines environmental sustainability as that situation in which "the physical flow of individual resources" is maintained, and "not merely the value of the aggregate". Tietenberg considers the criterion for sustainability not to lie in the form or structure of the artefact or the environment, but in the flow of resources between them that should remain constant. His focus is on the preservation of resource flows, where the underlying structures can change over time, and he takes the present resource flow as a point of reference. McElroy (2003)

stipulates sustainable innovation as an innovation process that itself is sustainable and brings forth sustainable outcomes. His ideas are based on complex adaptive systems theory (Holland, 1995), perceiving living systems to be self-organising and constantly fitting changes within its environment (McElroy, 2003). With his adoption of complex adaptive systems, McElroy adopts the idea of continuous adoption to an ever-changing environment, taking a dynamic and relative perspective towards sustainable innovation.

All mentioned definitions of sustainability, attribute sustainability to intangible artefacts. Therefore, all these definitions attribute sustainability to constructs.

An overview of the sustainability definitions

The theoretical contributions to the sustainability discussion are presented in Table 4.

The enumeration of the various contributions to the sustainability discussion confirms the main observation that sustainability is a concept difficult to grasp; many definitions exist that all approach sustainability from a different angle while, in principle, they all discuss the same issue.

As can be seen in the overview in Table 4, one may conclude that this article's assumption holds; the definitions of sustainability show conceptual developments. These developments are twofold. In the first place, a shift from an absolute to a relative perspective occurred, starting with Solow's (1986) and Repetto's (1985) contributions. This shift to a relative view on sustainability transformed the sustainability discussion into one that is able to perceive issues of sustainability from the present state of affairs, and opens up possibilities to act concerning this present state. In terms of Beth (1959), the objective of activities no longer is the ultimate Good, but the Better or the less Worse.

Secondly, the sustainability discussion turns away from a static perspective; it enters a path that regards sustainability from a dynamic angle. In a weak sense, the discussion already took this turn with Repetto's (1985) view on sustainability. As is displayed in Table 4, the discussion on sustainability did not directly follow Repetto's direction. A dynamic course was not explored again, until Meppen and Gill's (1998) contribution. The dynamic approach more accurately reflects the character of sustainability. However, because the changes of artefact and environment have to be taken into account while determining or improving an artefact's sustainability, the dynamic approach also strongly complicates the discussion.

According to the International Institute for Sustainable Development (IISD), Carson's (1962) publication of "Silent Spring" started the discussion on sustainability prior to the presented definitions. However, she demonstrated the link between usage of agricultural pesticides and damage to animal species and human health (IISD, 2003b) instead of using the term sustainability. If assumed that Carson's

Table 4. Chronological overview of sustainability definitions.

Decade	Firm Role Model	Author	Year of publication	Entity (1)/ Construct (2)	Absolute (1)/ Relative (2)	Static (1)/ Dynamic (2)
1960s	Efficient firm	UNESCO	1968	Undefined	Undefined	Undefined
1970	Quality firm	Pirages	1977	2	1	1
		Coomer	1979	2	1	1
1980s	Flexible firm	Allen	1980	2	1	1
		Porritt	1984	2	1	1
		Talbot	1984	2	1	1
		Tietenberg	1984	2	1	1
		Clark	1986	2	1	1
		Daly	1986	2	1	1
		Solow	1986	2	2	1
		Repetto	1986	2	2	2
		Barbier	1987	2	1	1
		Brown <i>et al.</i>	1987	2	1	1
		WCED	1987	2	1	1
		World Bank	1987	2	1	1
		Goodland and Ledec	1987	2	2	1
		Pearce	1987	2	2	1
		Markandya and Pearce	1988	2	2	1
Pearce <i>et al.</i>	1988	2	2	1		
Turner	1988	2	2	1		
1990s	Innovative firm	Meadows <i>et al.</i>	1992	2	1	1
		Pezzey	1992	2	1	1
		Pronk and Haq	1992	2	2	1
		Hart	1995	2	1	1
		Meppem and Gill	1998	2	2	2
		Elkington	1999	2	1	1
2000s	Knowledge firm	Tietenberg	2000	2	2	2
		McElroy	2003	2	2	2

(1962) publication is the starting point of the sustainability discussion, then the discussion started with addressing tangible artefacts, namely toxic chemicals, and animal and human populations. This entity-oriented approach represents the efficient firm of our reference timeline; the focus of both the sustainability discussion and the efficient firm lies on quantitative characteristics of toxic levels on the one hand and input/output ratios on the other.

Somewhere in the mid-1970s, this changes when sustainability is attributed to abstract constructs like society and development, which resembles the shift from the efficient to the quality firm. A focus on quality requires structural insights in the firm's production processes, and a more abstract perspective to pinpoint where actions need to aim at. Focussing on sustainability concerning society or development demands a similar abstraction.

In the mid-1980s, the adoption of a relative perspective in the sustainability discussion corresponds to the organisational shift towards the flexible firm. The shift towards the flexible firm demands profound knowledge about different markets a firm addresses, and about how process flexibility can be achieved.

The reorientation towards a dynamic perspective, in the mid-1990s, to a certain extent resembles the characteristics of the innovative firm; the innovative firm constantly responds to the demand for new products, requiring it to track its markets continuously and to adapt to occurring changes. The dynamic perspective enables the sustainability discussion to do the same: sustainability depends on the current situation that, due to ongoing changes of artefact and environment, can only be assessed at that particular moment in time.

With the apparent similarities between the reference timeline and the detected developments within the sustainability discussion, these developments can be extrapolated based on the trend of the reference timeline to the nearby future. Based on the extension of Bolwijn and Kumpe's (1990) classification, the sustainability discussion is expected to follow firm's developments towards the role model of the "knowledge" firm; towards a situation where more detailed, local knowledge is used within the sustainability discussion. A step in this direction follows from Banerjee's (2003) argument that the sustainability discussion has focused on environmental issues from a global point of view up to now. His claim goes further, stating that the sustainability discussion has neglected local specificities so far, and thus frustrates the whole idea of sustainability.

Although Banerjee (2003) approaches the sustainability issue from an environmental perspective, he has a point, here. He questions the current global perception of environmental problems within the sustainability discussion and the top-down enforcement of measures, claiming that this perception jeopardises local communities in their existence. Following this reasoning, sustainability cannot be seen as an issue that applies to the lump sum of the global human population, but concerns all elements of it.

In line with the development of firms, extrapolated from Bolwijn and Kumpe's (1990) classification, the next step within the sustainability discussion is the bottom-up consideration of local issues, concerning not only environmental problems, but sustainability in all its aspects. This new path does not look at sustainability from a global perspective, but explicitly recognises local specificities, still embracing a

construct orientation, a relative and dynamic perspective. This bottom-up approach does not replace the global, top-down approach: it is complementary.

Practical Contributions to Sustainability

Indicator lists and practical initiatives

The IISD (2003a) offers a database consisting of approximately 580 initiatives on its website, concerning practical contributions to the sustainability discussion. In order to determine whether the sustainability discussion experiences developments on the practical level, initiatives from the IISD website that are classified as global, multinational or international (IISD, 2003a) were considered. This selection of initiatives results in a set of policies, reports, indicator lists and guidelines, relating to either environmental issues or the topic of sustainability itself. Because of their different shapes and content, we focus upon the point of departure that constitutes the basis of each of these practical contributions.

An early initiative explicitly aiming at the realisation of sustainable development is the Dutch National Environment Protection Programme (NEPP) of 1989 (mentioned in Ministry of VROM, 2001). It can be seen that most initiatives that belong to the domain of sustainability are only addressing different elements of sustainability in a fragmented way; laws are installed to regulate the use of toxics and emissions of polluting substances (EPA, 1994). Institutions like the US Environmental Protection Agency (EPA) in 1970 (Kovarik, 2003) were established to protect the environment. After the publication of "The Limits to Growth" (Meadows *et al.*, 1972), attention of international and national governments concentrated on a thrifty use of ecological systems as a waste basket, focusing on solving immediate, existing environmental problems (Ministry of VROM, 2001). Therefore, the period prior to 1989 is seen as a period of environmental laws and policies, and with regard to the concept of sustainability, it is classified as a period of entity orientation, taking an absolute, static perspective.

With the Dutch NEPP initiative of 1989 (as mentioned in Ministry of VROM, 2001), this entity oriented, absolute and static perspective did not change instantaneously. Many practical contributions to the sustainability discussion remained at the level of an entity oriented, absolute and static perspective. Since 1989, policies have been developed that should guide development in directions towards either the protection and preservation of the environment or towards sustainable development. The World Resources Institute (WRI) and EPA set out a policy for, respectively, climate protection and the protection of environmental and public health (EPA, 2003; WRI, 2002). Whereas the WRI established absolute goals to reach between 2008 and 2012 (WRI, 2002), the EPA targets relative reductions or improvements of environmental systems in comparison to their present state (EPA, 2003). The

WRI explicitly states “that we work backwards from a desired future state of development” (WRI, 2002).

Policies from the International Joint Commission (IJC), and the Dutch Environmental Ministry (VROM) address a sustainable development, all from an absolute, static point of view (Ministry of VROM, 2001; IJC, 2002). The IJC and VROM take similar approaches, setting explicit goals to be reached within a fixed period, thereby realising a state of sustainable development without considering the nature of social, environmental or economic systems to change. None of them recognises the dynamics of the focal artefact or its environment. Because this absence makes it impossible for policies to cope with the dynamics of the world, the conclusion is that both initiatives assume a stable world that does not change over time; they have a static point of view.

Next to policies, reports have been used to inform people about the present state of the environment (Baumert *et al.*, 1999; Hulme *et al.*, 1999; WWF, 2002), about the progress towards a sustainable development (UNDP, 2002; UNEP, 2003) or about actions that need to be taken to reach sustainable development (UN, 1992a). The World Wildlife Fund (WWF) brought forth environmental reports, discussing, respectively, the state of animal life (WWF, 2002) and changes in the world climate (Hulme *et al.*, 1999). The WWF concludes that “to be sustainable, humanity’s consumption of renewable natural resources must stay within the limits of the Earth’s biological capacity over the long term” (WWF, 2002). Hulme *et al.* (1999) project the future in relation to greenhouse gas emissions, global temperature change and global sea-level rise, linking these phenomena to human cause. Because both project a state of environmental sustainability, both are considered to have an absolute, static view on sustainability. A similar perspective is used by the United Nations Development Programme (UNDP, 2002) and Baumert *et al.* (1999).

In contrast, the United Nations Environment Programme’s (UNEP) focus is upon a sustainable development (UNEP, 2003), taking a relative, dynamic standpoint. “Environmental policy development is a dynamic, iterative process encompassing assessment of the problems and options, target setting and policy formulation, followed by implementation, monitoring, review, evaluation, regular reassessment and adjustment” (UNEP, 2003).

Agenda 21 (UN, 1992a), which specifies different actions that need to be taken to achieve the construct of sustainable development, builds upon the principles stated in the “Rio Declaration on Environment and Development” (UN, 1992b). The Agenda sets clear objectives that need to be reached and ways to implement them, but does not recognise these objectives as a final state; it takes a relative approach towards sustainability. The underlying principles (UN, 1992b) build upon the principles of the WCED (WCED, 1987), and take a static approach.

The Bellagio Principles "serve as guidelines for the whole of the assessment process including the choice and design of indicators, their interpretation and communication of the result." (Hardi and Zdan, 1997). The first principle implies an absolute perspective on sustainability by stating that a clear vision and clear goals are essential to reach sustainable development. Principle nine states that the assessment should "be iterative, adaptive, and responsive to change and uncertainty, because systems are complex and change frequently" (Hardi *et al.*, 1997), implying a dynamic perspective. The Global Reporting Initiative (GRI) sets guidelines for sustainability reporting (GRI, 2000), taking a relative position concerning sustainable development. Next to this relative perspective, the GRI takes a dynamic standpoint by explicitly stating that the guidelines "represent the GRI Board's view ... at this point in time ..." (GRI, 2000). This statement explicitly connects the current guidelines to what the GRI board currently considers sustainable, recognising the possibility for this perception to change over time.

The set of indicator initiatives falls apart into a set addressing environmental issues (USDoE, 1995; Brunvoll, 1997; WRI, 2000; Kaly *et al.*, 1999; OECD, 1999, 2001; GEF, 2003), and a set that focuses on sustainable development (EEA, 2000; Hart, 2000; ICLEI, 2000; Singh and Gilman, 2000; Cobb *et al.*, 2001; Eurostat, 2001; UN, 2001; DJSI, 2002; Nickerson, 2002; Florschütz *et al.*, 2003). The environmental oriented initiatives focus on issues like improving energy efficiency (USDoE, 1995), assessing the state of the environment (WRI, 2000), assessment of environmental performance (GEF, 2003), measuring air quality (OECD, 1999), measuring environmental vulnerability (Kaly *et al.*, 1999), indicating pressure on, state of and responses to the environment (Brunvoll, 1997) and displaying the condition of the environment (OECD, 2001). Of these indicator lists, only the OECD (1999, 2001), Brunvoll (1997) and Kaly *et al.* (1999) take a relative approach towards sustainability. For example, Kaly *et al.* state explicitly "the aim of vulnerability indices is to describe the relative vulnerability of states" (Kaly *et al.*, 1999). Both Kaly *et al.* (1999) and the OECD (1999) have a dynamic perspective.

Initiatives considering sustainable development that originate from Hart (2000), Singh and Gilman (2000), the International Council for Local Environmental Initiatives (ICLEI) (2000), Nickerson (2002), the United Nations (UN) (2001) and Eurostat (2001), all take an absolute approach towards sustainability. For instance, Hart states that "[s]ustainability is related to the quality of life in a community" (Hart, 2000). None of these indicator initiatives explicitly recognises dynamics of the considered artefact and its environment. Therefore, they are classified as static.

Florschütz *et al.* (2003) choose a relative point of view, regarding, respectively, sustainable entrepreneurship and corporate sustainability. They explicitly base their indicators on the idea of a relative comparison between organisations, quoted on

the Amsterdam Effect eXchange (AEX). Florschütz *et al.* (2003) do not explicitly indicate they consider sustainability as a dynamic issue.

An overview of sustainability in practice

Table 5 presents an overview of the discussed practical contributions to the sustainability discussion. Because the practical initiatives form a heterogeneous set, consisting of reports, policies, guidelines and indicator lists, the framework has been extended with a column indicating the different types of initiatives. At first sight, Table 5 does not show similar developments to those observed in Table 4.

Looking at the different types of initiatives, some developments are observed that have occurred over time. Policies alternated between an entity and construct orientation, while holding on to an absolute, static perspective on sustainability. Sustainability reports have only recently left a long-held entity oriented, absolute and static perspective, adopting instead a construct orientation, taking a relative, dynamic approach towards sustainability. A similar shift can be seen among the considered guidelines.

Concerning the indicator lists of our set, developments are not identified as easily. Looking at indicator lists only from a chronological point of view, no pattern of a clear, mutually understood focus is visible. For a long time the contributions have an absolute and static perspective towards sustainability, lacking a shared, mutual alignment.

However, splitting up the set of indicator lists into entity and construct oriented indicator lists (see Tables 6 and 7), and ordering them chronologically, developments become visible concerning the absolute–relative and static–dynamic aspects over time. Both entity and construct-oriented indicator lists developed over time from an absolute to a relative approach towards sustainability. Whereas the construct oriented indicator lists hold on to a static approach, the entity-oriented lists adopted a dynamic approach regarding sustainability.

The firm developments, as observed by Bolwijn and Kumpe (1990), are of limited help concerning the developments of the practical contributions to the sustainability discussion. A turn has been observed at the end of the 1980s, with the implementation of the Dutch NEPP of 1989 (as discussed in Ministry of VROM, 2001). Before the 1980s, most efforts, now considered from the sustainability perspective, concerned environmental laws (Kovarík, 2003; EPA, 1994). The difference between these two periods is from a fragmented towards an integrative approach to environmental problems.

However, one can observe developments with regard to the considered initiatives that are similar to the developments forming the basis for the analysis of firms, but in a considerably shorter period. Developments continue, taking a course resembling

Table 5. Chronological overview of practical sustainability initiatives.

Decade	Firm Role Model	Source	Initiative Type	Year of Publication	Entity (1)/ Construct (2)	Absolute (1)/ Relative (2)	Static (1)/ Dynamic (2)
1960s	Efficient firm			Various	1	1	1
1970s	Quality firm	EPA (1994), Kovarik (2003)					
1980	Flexible firm						
1990s	Innovative firm	Agenda 21	Report	1992	2	2	1
		USDoE	Indicator list	1995	1	1	1
		Brunvoll	Indicator list	1997	1	2	1
		Hardi <i>et al.</i>	Guideline	1997	2	1	1
		Baumert <i>et al.</i>	Report	1999	1	1	1
		Hulme <i>et al.</i>	Report	1999	1	1	1
		Kaly <i>et al.</i>	Indicator list	1999	1	2	2
		OECD	Indicator list	1999	1	2	1
2000s	Knowledge firm	EEA	Indicator list	2000	2	1	1
		GRI	Guideline	2000	2	2	2
		Hart	Indicator list	2000	2	1	1
		ICLEI	Indicator list	2000	2	1	1
		Singh <i>et al.</i>	Indicator list	2000	2	1	1
		WRI	Policy	2000	1	1	1
		Cobb <i>et al.</i>	Indicator list	2001	2	2	1
		Eurostat	Indicator list	2001	2	1	1
		Ministry of VROM	Policy	2001	2	1	1
		OECD	Indicator list	2001	1	2	2

Table 5. (Continued)

Decade	Firm Role Model	Source	Initiative Type	Year of Publication	Entity (1)/ Construct (2)	Absolute (1)/ Relative (2)	Static (1)/ Dynamic (2)
		UN	Indicator list	2001	2	1	1
		DISI	Indicator list	2002	2	1	1
		IJC	Policy	2002	2	1	1
		UNDP	Report	2002	1	1	1
		WRI	Policy	2002	1	1	1
		WWF	Report	2002	1	1	1
		EPA	Policy	2003	1	1	1
		Florschutz <i>et al.</i>	Indicator list	2003	2	2	1
		GEF	Indicator list	2003	1	1	1
		UNEP	Report	2003	2	2	2

Table 6. Chronological overview of indicator lists: entity conceptualisations.

Decade	Firm Role Model	Source	Initiative Type	Year of Publication	Entity (1)/ Construct (2)	Absolute (1)/ Relative (2)	Static (1)/ Dynamic (2)
1990s	Innovative firm	USDoE	Indicator list	1995	1	1	1
		Brunvoll	Indicator list	1997	1	2	1
		Kaly <i>et al.</i>	Indicator list	1999	1	2	2
		OECD	Indicator list	1999	1	2	1
2000s	Knowledge firm	OECD	Indicator list	2001	1	2	2
		GEF	Indicator list	2003	1	1	1

Table 7. Chronological overview of indicator lists: construct conceptualisations.

Decade	Firm Role Model	Source	Initiative Type	Year of Publication	Entity (1)/ Construct (2)	Absolute (1)/ Relative (2)	Static (1)/ Dynamic (2)
2000s	Knowledge firm	EEA	Indicator list	2000	2	1	1
		Hart	Indicator list	2000	2	1	1
		ICLEI	Indicator list	2000	2	1	1
		Singh <i>et al.</i>	Indicator list	2000	2	1	1
		Cobb <i>et al.</i>	Indicator list	2001	2	2	1
		Eurostat	Indicator list	2001	2	1	1
		UN	Indicator list	2001	2	1	1
		DJSI	Indicator list	2002	2	1	1
		Florschutz <i>et al.</i>	Indicator list	2003	2	2	1

firms in Bolwijn and Kumpe’s (1990) analysis, and similar to the developments that were found concerning the theoretical contributions to the sustainability discussion, from a global towards a local orientation. As part of the sustainability discussion, the Eurostat (2001) initiative discusses exactly this issue of using knowledge of local contexts in relation to sustainability by recognising “the limitation of a ‘global’ perspective for evaluating all aspects of sustainability (i.e., a single figure for the whole world)” (Eurostat, 2001). In order to overcome these limitations, a global perspective “needs to include national and local dimensions as well” (Eurostat, 2001), so it reflects sustainability in detail. To put it more strongly, emphasising this local dimension forms a necessary step towards actions aimed at sustainability. It is at this level of aggregation that the contributions or effects of policy or any other

form of agreement on sustainability are implemented. One can state that in order to be effective, a profound understanding of the context of intervention is essential.

Conclusion and Discussion

In this article, we made a U-turn curve with respect to our conception concerning sustainability. Our research into sustainable innovation started with the idea that, given the broad discussions about sustainability over the last 10–15 years, especially in organisations, some clear definitions and indicator lists would be available. That turned out to be not true. Many definitions and indicator lists were found. Moreover, it seemed that the definitions and indicator lists were ill defined, incomplete and often contradictory. Because clarification was needed, also for our empirical research (Jorna *et al.*, 2004), we constructed a framework with which we could analyse underlying conceptual developments concerning sustainability from the recent past until the present. The framework consists of the aspects of kind of artefact, goal orientation and behavioural interaction. That framework was useful. Conceptual developments of sustainability could be made visible.

In Figs. 1 and 2, the developments concerning the sustainability concept are depicted with respect to the three aspects for definitions and indicator lists,

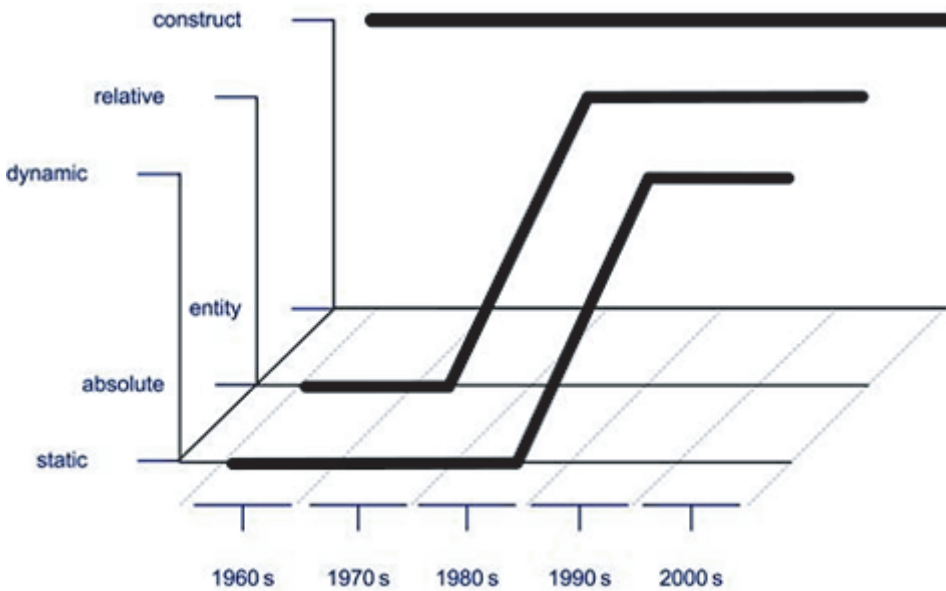


Fig. 1. The development over time of definitions of “sustainability” with regard to the aspects of artefact (entity–construct), goal-orientation (absolute–relative) and interaction (static–dynamic).

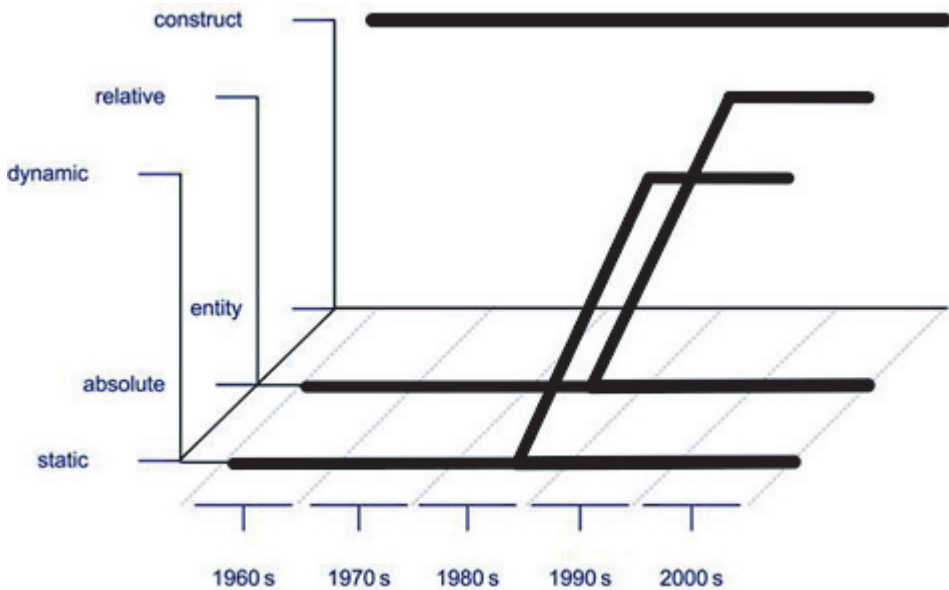


Fig. 2. The development over time of indicator lists of “sustainability” with regard to the aspects of artefact (entity–construct), goal-orientation (absolute–relative) and interaction (static–dynamic).

respectively. We see that the earliest definitions of sustainability had a construct, absolute and static view on what sustainability is about. However, the sustainability discussion developed further to the point where sustainability shifted from an entity towards a construct orientation, from an absolute towards a relative perspective and from a static towards a dynamic perspective on sustainability. Especially the shift towards a relative and dynamic perspective is an important step in the sustainability discussion. A relative perspective opens a window on the state of the world as it is and not to a visionary image of a world as it ought to be. Sustainability no longer targets an ultimate sustainable state, but instead becomes a process of constant improvement of the sustainability of artefacts. The dynamic perspective enables the discussion to recognise and deal with ongoing changes of the world.

The difference between definitions and indicator lists is that the construct orientation took place concerning the indicator lists, in a very early phase. Although it took longer, the same can be said for the change from absolute to relative and from static to dynamic. Summarised, similar developments took place concerning definitions and indicator lists, but much faster for the indicator lists.

The classification of the development of responses of firms to markets and internal developments, which we used as a reference timeline, showed interesting parallels of transformation with the developments within the sustainability discussion. Firms changed from ideal types of the efficient, into the quality, into the flexible

and into the innovative organisation. An extrapolation indicates a development to a new kind of firm: the knowledge firm. This may partly coincide with developments in the discussion of the development of knowledge management: the so-called open enterprise (Firestone and McElroy, 2004).

Following Bolwijn and Kumpe's (1990) classification, the knowledge firm focuses on structural aspects in order to comply with the new market demands, installing new organisational functions in an organisation's design and setting of dialogue and transparency that facilitate knowledge input from and knowledge output to its stakeholders. Gradually, the free flow of knowledge inwards, outwards and throughout the organisation will be necessary to synchronise with the new market requirements of stakeholder involvement and openness. Stakeholders' knowledge enters the firm easier and more intensely, up to the point that stakeholders become part of the process of organisational decision-making. The aspects of the innovative firm enable organisations already to realise their innovations using knowledge and expertise of its employees, through the cultural change of participation and democratisation. They are necessary preconditions for the "knowledge" firm that characterises the 2000s.

From a policy perspective, organisations that want to make the complex concept of sustainability a part of their business need to understand that sustainability no longer is perceived as an achievable goal, but as a continuing process of improvement, requiring constant effort; they have to adopt the construct-oriented approach, and a relative, dynamic perspective. Dealing with sustainability from the old perspective does not synchronise an organisation's activities concerning sustainability with the present state of the sustainability discussion. Because the new approach towards sustainability recognises continuous changes of the world and tackles current sustainability problems, organisations are forced to work with continuous learning. In the coming decade, knowledge is the power instrument for shaping the sustainability discussion within the organisational context.

The sustainability discussion also has to acknowledge that the explicit recognition of local characteristics plays an essential role. The discussion already developed to a point where sustainability is regarded as an issue relative to the present situation in time, considering the dynamics of the world; a point where sustainability can be approached pragmatically and realistically.

The adoption of a local perspective, complementary to the already present global perspective, is only the next step of increasing complexity in the sustainability discussion, improving its accuracy both in conceptualisation and in action, requiring the acquisition of more profound and detailed knowledge. The implication of this new, bottom-up course to the sustainability discussion is the explicit recognition that sustainability concerns local contexts, on both theoretical and practical planes,

providing a more fine-grained perspective on the complex topic of sustainability, and involving more detailed knowledge. Definitions of sustainability need to take aspects of locality into account in some form or another. Sustainability policies, reports, guidelines or indicator lists need to incorporate local measures in order to fully contain the issue of sustainability. With this new path for the sustainability discussion, knowledge is again the decisive factor (McElroy, 2003; Jorna *et al.*, 2004).

Following the expected course of the sustainability discussion, organisations are forced to install new organisational functions that can deal with local characteristics. In accordance with the reference timeline, this new path of the sustainability discussion demands changes to the organisation's structure, concerning dialogue and transparency. Dealing with local characteristics requires organisations to be able to detect, process and act upon developments at the local level. Again, the new course of sustainability implies a further deepening of knowledge. Within an organisational context, the developments up to now changed sustainability from an organisational goal into an integral part of organisational processes, demanding constant effort and learning. The new path of the sustainability discussion seems to bring nothing less. As a process of learning and knowledge creation at the level of the human individual as well as at the level of the organisation, innovation will even more strongly be the real sustainable factor in the organisational context.

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