SWEDISH LIFE CYCLE CENTER

Is individuals' surplus time a feasible end point indicator for sustainable development?

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Discussion paper

Within the following pages lies a discussion paper curated by the Swedish Life Cycle Center. It's essential to note from the outset that the viewpoints expressed herein do not represent the official position of our organization. Rather, they reflect the interests and insights of some of our esteemed members who have found them worthy of sharing. We invite you to explore these perspectives, recognizing the varied viewpoints that contribute to the depth of our discourse.

Abstract

Sustainable development is multidimensional. UN has 17 Sustainable Development Goals and a multitude of targets and indicators. However, choices made for implementing sustainable development frequently require aggregation of indicators. The aim of this work is to test the feasibility of using individuals' surplus time as a single end point indicator. The time we mean is the time individuals have left when they have satisfied their basic needs without compromising the ability of future generations to satisfy their needs. The time needed for sustainably satisfying basic needs is determined as the sum of unpaid time, paid time, and compensation time. The concept of Decent Living Standards is used as a proxy for basic needs satisfaction and to make the indicator assessment operable. The feasibility of the indicator is evaluated by life cycle assessment of four different consumption choices. We find that surplus time maximization is a feasible functional indicator of the SDGs, primarily for product development, but also useful in other contexts. Using individual surplus time as an indicator will not only allow a trade-off between environmental and economical aspects, but also include individuals own, unpaid time. This may e.g., lead to new views on poverty and wealth.

Contents

1. Introduction

The need for a sustainable development has been widely recognized since the UN conference in Rio 1992. Various indicators have been suggested to guide and monitor sustainable development progress. Almost all of them address specific aspects of sustainable development, but there are also attempts to integrate them in single indicators [1]. The perhaps most well-known indicators are those of the UN sustainable development goals [2], where 231 different indicators are specified [3].

Several articles address problems and challenges in formulating good indicators [4-7]. These include different ideas of what to be sustained, what to be developed, how to link environment and development, and for how long. Other challenges are adaption to varying decision contexts, data availability and confusion in terminology. Most sustainable development indicators are developed from a governmental monitoring perspective. Considerable research is still needed on the sensitivity of the indicator system to scale (going from country level to organizations and products), aggregation method, critical limits, and thresholds [6].

Aggregation of different sustainability indicators is particularly needed in decision contexts, where there are trade-offs and synergies between different indicators and where there are several other concerns to include besides sustainable development. Purchasing, investments and technical developments are such contexts.

In life cycle assessment (LCA) methodology weighting and aggregation of environmental impact indicators is often applied. Three types of approaches exist: distance-to-target, monetary and panel methods. Sometimes they can be combined.

Distance-to-target methods often relate to governmental targets, like emission reductions and ambient air and water standards [8]. Sometimes targets may be set by scientific communities, like the “planetary boundaries” [9, 10]. Distance to target methods have a potential to assess “absolute sustainability” instead of “relative sustainability”, which is the case for monetary and panel methods.

Monetary methods are mostly based on people’s willingness to pay (or accept compensation for) a change in environmental quality or based on abatement costs [11-18]. At a first glance results from monetary methods may seem easy to understand, but their interpretation requires a second thought, as results may vary considerably due to whose values that are assessed, what is included and how.

Panel methods is based on opinions from representative samples of people affected by the impacts. Conjoint analysis is a panel method used in LCA [19, 20]. Panel methods may be seen as an estimate of perceived sustainability, which is relevant for organisations trying to satisfy the concerns of their stakeholders. But opinions may change quickly, why estimations must be repeated often.

MCDA, multi criteria decision analysis, is a common process of addressing aggregation, and has mainly been used for other issues than sustainable development but is applicable also there [21]. It may be seen as a panel method, where decisionmakers are identified and constitute the panel. There are thus many options of aggregated sustainability indicators, but in LCA they are mostly limited to environmental impacts. For sustainable development, economic and social impacts also need to be included.

Sustainability has, in essence, the dimension of time, like a date on a milk package. Depending on what is going to be sustained, there is one or maybe a few critical features determining time to breakdown. Such features should be of prior interest in finding relevant integrated sustainability indicators.

This article suggests an approach, where the critical sustainability feature is the time individuals have left, when they have satisfied their basic needs. This will in the following text be denoted as "surplus time". There are several reasons why surplus time can be a useful indicator:

1. It is independent of culture and specific living conditions. Basic needs are common to all individuals and generations, as are available time to satisfy them.
2. It is absolute. There is a clear boundary for unsustainability. Our time is limited.
3. Surplus time is relevant for describing human development history, from hunter-gatherer times, through agricultural and industrial eras (figure 1).
4. It is a common interest in society to promote people's capabilities to satisfy their basic needs within a reasonable time. This role of the society is reflected in the Brundtland report "Our common future", which largely address basic needs [23].

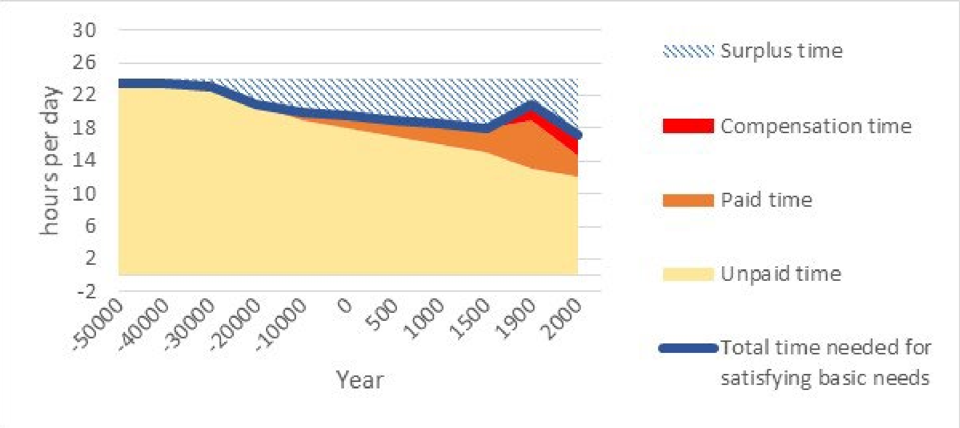

Figure 1: *Historical development of time needed to satisfy basic needs in a group of people assumed to live a sustainable life. Compensation time is the time one has to work to compensate for external impacts due to consumption.*

In the case in Figure 1, there are, for the year 2000, about 2.5 hours of work needed for buying goods and services for basic needs, and the compensation time is about 2 hours. These data are estimations made from statistics on how people use their time [32]. Compensation time is determined from the total costs of global impacts [33] and peoples salaries.

Our hypothesis is that individual surplus time is a feasible indicator for guiding sustainable development. The aim of this article is to test if individuals' surplus time is feasible as an aggregated indicator for guiding sustainable development in four decision cases.

2. Materials and methods

To investigate the feasibility of surplus time as an indicator, we carry out four case studies.

Time surplus represents an **end (and thereby an overarching SDG indicator)**, while human, social, environmental, and economic resources are **means** to reach that end. Aspects and indicators of the means become relevant and material through their ability to influence the end. The time needed for a decent living standard, which is used as proxy for satisfying basic needs, consists of three categories: paid time (the time one must work to buy a product or service), unpaid time (e.g., time to prepare food) and compensation time (working time needed to avoid external impacts or compensate others for external impacts (such as impacts caused by emissions and the use of natural resources). Individuals' surplus time is determined as total available time minus the sum of working time, unpaid time, and compensation time to pay for cost of a decent living standard. LCA with monetary valuation of external impacts is used to determine externalities. Individuals' salaries are used to convert external cost to compensation time, as they represent the time an individual need to work to compensate the damage caused by his or her consumption.

2.1 Challenges in application of (surplus) time as an indicator

To make (surplus) time a useful indicator, it must be possible to assess in practice. Sufficient accuracy must be possible to achieve with reasonable resources. How to frame and define basic needs, determine their satisfaction, how to determine time use, and how to assess impacts on time use from human activities are challenges that must be managed before surplus time can be used as an overarching sustainability indicator.

2.1.1 Identifying basic needs and their satisfiers

There are several publications framing and identifying basic needs [24-28]. There seems to be a type of consensus about which basic needs there are, and what satisfies them, although several ideas exist for how to characterize needs and how they relate to each other. Satisfaction of physical needs, like food and shelter, may be linked quantitatively to material flows and technical processes. Social needs are more difficult to link in quantitative terms, partly because there are no indisputable cause-effect relationships and partly because of individual variations. The work of Rao and Min [29] gives an indication of how to proceed to an operational level to reach a material "decent living standard (DLS)". They classify material needs as either contributing to physical wellbeing (good health and security) or to social wellbeing (critical autonomy). Satisfiers, or as they call it "essential requirements for wellbeing", are given on three levels: individual, community, national. They go beyond subsidence and strict basic needs, which is why their requirements become dependent on the living conditions of the present and lose some of the independence from culture and generations, but in return the criteria become concrete and easier to analyse. Their focus on "the definition of a DLS, not its realization" limits the direct use of a DLS for innovation and development of new technology but helps indirectly through facilitating identification of services relevant for a DLS.

2.1.2 Determining basic needs satisfaction

There are degrees of satisfaction on a scale between unsatisfaction and satisfaction. Additionally, needs may vary from person to person and from time to time. For physical needs, like air, water, food, temperature, there are good data on what is needed on average. The number of calories, amount of water, amount of air, etc. are relatively well known. But for phycological and social needs, quantitative data are less available. Phycological tests exist [30] [31] that can measure how some of these needs are satisfied. Such tests are however not common and available for sustainability assessments.

To overcome the problem of measuring needs satisfaction per se, which involves knowledge on where on the satisfaction scale you are, we restrict the indicator to "capabilities to satisfy needs". Such capabilities are described in the DSL methodology.

2.1.3 Determination of time use

Time should not be difficult to measure exactly, but as many needs may be satisfied at the same time it, there may be an allocation problem. A dinner may satisfy both physical and social needs. Some may be basic, some not.

The time currently used to satisfy basic needs should be possible to estimate from using surveys. Table 1 shows an example from OECD statistics on how people spend their time [32]. In this example it is data from Germany, but data are also available for all other OECD countries plus China, India and South Africa.

Table 1: *How people between 15 and 64 spend their time (in minutes per day). Example from Germany 2012/2013. Source OECD [32].*

1.0	**Paid work or study**	**248**
1.1	paid work (all jobs)	191
1.2	travel to and from work/study	28
1.3	time in school or classes	14
1.4	research/homework	10
1.5	job search	1
1.6	other paid work or study-related	4
2.0	**Unpaid work**	**196**
2.1	routine housework	109
2.2	shopping	32
2.3	care for household members	19
2.3.1	child care	18
2.3.2	adult care	1
2.4	care for non household members	6
2.5	volunteering	6
2.6	travel related to household activities	20
2.7	other unpaid	3
3.0	**Personal care**	**648**
3.1	sleeping	498
3.2	eating & drinking	95
3.3	personal, household, and medical services + travel related to personal care	55
4.0	**Leisure**	**331**
4.1	sports	26
4.2	participating / attending events	14
4.3	visiting or entertaining friends	61
4.4	TV or radio at home	118
4.5	Other leisure activities	112
5.0	**Other**	**17**
5.1	religious / spiritual activities and civic obligations	3
5.2	other (no categories)	14

2.1.4 How to assess impacts on time use from human activities

The link between a human activity and surplus time may be complex. If, for instance, you choose to go by bus to buy food, instead of taking the car, there is a series of consequences to the time used. Not only the time used for shopping, but also for preparations, working time to cover costs, and coupled processes. A system approach is needed with all its requirements on defining goal and scope, system boundaries, allocation, data quality and modelling. Here, the methodology and data from life cycle assessments are used.

The determination of working time to cover costs is a particular challenge. Should taxes of different kinds be included? For an employed individual at a particular moment there is a well-defined relation between working time and cost, based on the net income after taxes. A non-working individual like a child or retired person earning no current personal income cannot directly cover the costs of their environmental damages so it is not feasible to calculate their individual working time. Similarly, any person living on savings or interest earned on capital contributes zero working time to covering these costs.

But in real life, money is transferred between working and non-working persons and over time. So, on a society level, and on a product system level, the average salary per time unit in a country seems to be a reasonably good value to use to quantify working time use per cost unit.

2.2 Operationalization

To use surplus time as an indicator, there should at least be one practical way of assessing how it relates to human activities. One such way, identified here, is to define a basket of goods and services supplying satisfiers to basic needs. Each good or service can be described by a set of unit processes in a supply chain. Each unit process involves the use of time in the three categories mentioned above: unpaid time, paid time, and compensation time.
The paper of Rao and Min [29] "*sets out first principles towards defining a specific basket of goods and services for individuals in a particular society*". They list a basket of goods and services needed for a decent living standard (DLS). A modified version of their list is shown in table 2. The time needed for a specific activity is the sum of all service times needed for that activity.

Table 2: *Services needed for a decent living standard. Modified from Rao and Min [29]. *EOL means end-of-(product) life.*

DLS dimension	Service or material required, supply per person	Unit processes
Physical wellbeing		
Nutrition	2000 calories/day	Production, transport, storage, preparation, eating
Living conditions	Residential space of 20 m^2/person	Production, transport, maintenance, EOL*
	Temperature 18 – 25 degrees Celsius	Production, transport, maintenance, EOL
	Water, 50 L/person, day	Production, transport, maintenance, EOL
	Sanitation, disposal of 1 person-equivalent/day	Production, transport, maintenance, EOL
	Clean clothes, 2 kg for 1 week	Production, transport, maintenance, EOL
Health care	Two 30 minutes contact with a physician per year	Production, transport, maintenance, EOL
Social wellbeing		
Education	9 years of education	Production, transport, maintenance, attendance
Communication	Phone	Production, transport, maintenance, EOL

Information access	TV/radio/internet	Production, transport, maintenance, EOL
Mobility	20 person-km per day by public transport or vehicle	Production, transport, maintenance, EOL
Freedom to gather, dissent	Public space, x m^2/p	Production, transport, maintenance, EOL

2.2.1 Nutrition

We have restricted the requirement from Rao and Min for nutrition to only calories, as deficiencies in protein and micronutrients seldom occur when the calory need is satisfied, and as it would complicate the analysis unreasonably much. The time required for nutrition services is hours needed for a person for a daily intake of 2000 calories. It includes production, procurement, transports, storing and preparation.

2.2.2 Living space

The time required for providing living space is hours used per day, person and 20 m^2 with solid walls and roof, excluding heating/cooling, water and sanitation. It includes production, maintenance, and end-of life processes. Heating/cooling, water supply and sanitation are excluded, but electricity for light and cooking are included.

2.2.3 Temperature in living space

The time required for decent temperature is hours used per day to keep the temperature in the living space between 18 and 25 ^{O}C. It includes production, transport, maintenance, and end-of life processes. It is likely to vary a lot between different climate zones.

2.2.4 Water supply

The time required is hours for the supply of 50 L/day of water. Compared to Rao and Min's list we added a requirement of drinking water quality. It includes production, transport, and maintenance. End-of life processes are dealt with in connection with sanitation.

2.2.5 Sanitation

The time required for sanitation is hours for disposal of 1 person-equivalent per day, including 50 L/day of water. It includes production, transport, and maintenance of sanitation products and infrastructure.

2.2.6 Clean clothes

Rao and Min have proposed that the service should be a certain m^2 of clothing. We propose to use the indicator in kg, as washing resources and prices are better correlated to the weight of the textiles. The time required to supply 2 kg clean clothes for 1 week is used as an indicator of the service. This means that production, distribution, washing, and end-of-life processes are included in the life cycle. If, for instance, the service time for a sweater is analysed, it will include manufacturing, purchasing, washing intervals depending on material and use type, and assumptions about lifetime.

2.2.7 Health care

Rao and Min have proposed a service on society level, i.e., about 1.5 physicians per 1000 people. On an individual level this would correspond to about two 30-minutes treatment by physicians per year. A visit includes transport, time for waiting and treatment and possibly medicals.

2.2.8 Education

The service is access to 9 years in school, which may be expressed in minutes per day as in table 1. Unit processes includes production of buildings and equipment, transport, maintenance, and attendance.

2.2.9 Communication

Rao and Min suggest access to a phone as the material requisite for communication. To be able to quantify the time needed for all choices concerning communication, the service required for a DLS must be further specified. Here we specify the service as one phone call 0.2 hours per day. Unit processes include production, maintenance, transports, and end-of-life management.

2.2.10 Information access

TV, radio, internet are material requisites for access to information. We specify the service required for a DLS to 1 hour per day. Unit processes include production, maintenance, transports, and end-of-life management.

2.2.11 Mobility

Public transport and vehicles of various kind is material prerequisites for mobility. The service required for a DLS is chosen to be 20 person-km per day. The unit processes for production, transport, maintenance, and end-of-life management are included.

2.2.12 Freedom to gather, dissent

Rao and Min have proposed a certain amount of public space to be available per person. In modern life, there are many opportunities via internet to gather and express dissent but that does not exclude public space to be a prerequisite for a DLS. The service required for a DLS is difficult to specify, as it is unclear what a public space for gathering is, and how to measure access. From an individual's time perspective, the area, the time to get there and the population density around it would be factors that may be used to define a service unit, but at present we have found no unit and amount of service for a DLS.

3. Calculations and results

The feasibility of using individuals' surplus time as a single overarching indicator for sustainable development is tested through four different consumer choices. Detailed references to data used are left out, as the results per se is not important for assessing the feasibility, only the ability to find data and interpret the results. External costs due to emissions and the use of natural resources are estimated using the EPS 2020d impact cost data [35] and Ecoinvent and GaBi elementary flow data [36].

3.1 Choice between sirloin steak and fish for dinner

This example is about a choice between 150 g of sirloin steak and 150 g of fish for dinner. It is assumed that only time for nutrition service is relevant. Living conditions are assumed to be influenced in the same way for both alternatives. Both the steak and the fish contain 140 calories. The price for the steak is 25 €/kg and for the fish 15 €/kg, and the cooking time somewhat lower for the steak (6 minutes) than for the fish (12 minutes). The paid time needed would then be 25x0.15/27 = 0.139 hours for buying the steak and 15*0.15/27 = 0.083 hours for buying the fish. Costs for cooking is assumed to be comparatively low and negligible. The division with 27 €/hour converts the cost to time and is based on average salaries. The unpaid time consists of shopping, cooking, and eating. Shopping and eating are supposed to be the same for both meat and fish and estimated to 0.3 hours. Cooking is assumed to be somewhat quicker for the sirloin steak, which only needs frying in a pan (6 minutes), while the fish needs some preparation before frying (12 minutes). The total unpaid time is therefore 0.4 hours for the steak and 0.5 hours for the fish. External costs are estimated to 10 €/kg for the steak, and 1.6 €/kg for the fish, using the EPS 2020d impact cost data [35] and Ecoinvent elementary flow data [36]. Compensation time is therefore 10x0.15/27 = 0.056 hours for the steak and 1.6x0.15/27 = 0.009 hours for the fish. Total time for the steak is thus 0.139+0.4+0.056 = 0.595 hours and for the fish 0.083+0.5+0.009 = 0.592 hours. Recalculated to the required service for a DLS, i.e., 2000 calories/day we get 8.50 hours for the steak and 8.46 hours for the fish. The results thus show that the data needed was available, and possible to understand as the alternatives had about the same impact.

3.2 Choice between repairing an old washing machine and buying a new one

This example concerns a choice between repairing an old washing machine and buying a new. The concerned service required for a DLS is supplying clean clothes, and the required service is the supply of 2 kg clean clothes per week. The unit processes assessed in this example is purchasing, washing, ironing and waste management. The handling of the laundry, i.e., loading, unloading etc. that is the same for both alternatives is left out of the analysis. Basic data on the options are given in table 3.

Table 3 basic data on alternatives.

Table 3: *Basic data on alternative washing machine options.*

	Repairing old machine	New machine
Investment, €	200	1000
Electricity use, kWh/1000 kg textiles	250	200
Detergent use, kg/1000 kg	12	10
Water use, m3/1000 kg textiles	12	10

Assumed remaining lifetime, years	5	20
Assumed use kg textiles/year	500	500
Price of detergent, €/kg	2.5	2.5
Price of electricity, €/kWh	0.3	0.3
Price of water, €/m3	1.5	1.5
Added weight, kg	1	90
Stainless steel, %	0	18
Steel, %	30	60
Copper, %	20	2
Plastics, %	50	20
Degree of recycling of steel, %	90	90
Degree of recycling of Cu, %	0	0
Degree of recycling of plastics, %	50	50

Using these data in a simplified LCA/LCC and expressing them on the basis of laundering 1000 kg of textiles, results in the performance data shown in table 4. The time gained when using the new machine is estimated from decreased need for ironing, as the laundry is less wrinkled when taken out of the machine.

Table 4 Results from LCA/LCC of maintenance of textile function.

Table 4: *Results from LCA/LCC of maintenance of textile function.*

Costs and Time indicator/1000 kg textiles	Repairing old machine		New machine	
	cost, €	time, hours	cost, €	time, hours
Investment, (paid time)	80	3.0	100	3.7
Use (paid time + unpaid time)	123	4.6	100	3.7
Environmental externalities (borrowed time)	187	6.9	194	7.2
Time savings in use of new machine (unpaid time)	0	0.0		-8.0
sum	390	14.4	394	6.6

The results show that without considering savings in time for the user, the alternatives seem to be equally attractive. When including time, the new machine alternative clearly becomes the most attractive.

To compare the results with the required DLS service, i.e., 2 kg clean clothes during a week, we need to know the washing frequency. In this example it is estimated to an average of 3 days per kg, or 0.33 kg per day, which means that washing with the repaired old machine would require 14.4/1000*0.33 = 0.0048 hours and washing with the new machine would require 6.6/1000*0.33 = 0.0022 hours per day excluding loading and hanging the laundry to dry, a factor 2 difference.

In terms of feasibility this case showed that input data was reasonably easy to collect, and the result was easy to interpret.

3.3 Choice between design options of a bus

This example is about a bus design option for a public transport provider. It is about the size of a bus. The DLS service concerned is mobility, and the overarching performance indicator is hours per person-km. Characteristics for the alternatives are shown in table 5. Hours used per person-km are evaluated for a fictive tour of 40 km, with a roundtrip time of 2 hours including runtime and rest for the driver at the end stop. The passenger flow is 5600 person-km per day. The small bus option has twice as frequent tours and shorter time at the stops compared to the big bus option. More frequent tours and more stops save time for the user to get on to the bus but is more expensive.

***Table 5**: Design options for a bus.*

	Characteristics	
Feature	**Bus A**	**Bus B**
Weight, kg	5000	3000
Passenger capacity, persons	40	20
Fuel use, kg/10 km	3	2
Time at bus stops, minutes	1.5	1
Average driving velocity, km/h	30	30
Lifetime, km	1 000 000	1 000 000
Average passenger travel distance, km	10	10
Number of stops	20	30
Ticket cost, €/single journey	0.15	0.27
Used passenger capacity, %	50	50

Assuming a price of 30 €/kg for the buses, a labour cost for the driver of 30 €/hour, and fuel& maintenance cost of 0.3 €/km we get a ticket cost of 0.15 €/10 km and 0.27 €/10 km for bus A and B respectively. The corresponding paid time is shown in table 6 together with own time used and borrowed time. Due to savings in unpaid time, bus B is a better option for sustainable development than A, despite higher environmental impacts and costs.

***Table 6:** Time used for a 10 km bus trip.*

	Time use, hours	
Time indicator	**Bus A**	**Bus B**
Ticket price, (paid time)	0.056	0.100
Boarding time (own time)	0.2	0.1
Travel time (own time)	0.4	0.4
External costs (compensation time)	0.013	0.033
sum	0.66	0.60

3.4 Choice between concrete and wood in a house wall

This example is about choosing material in a house building wall. The example is different from the earlier examples as it involves two DLS services: space and indoor temperature. It introduces a problem in choosing performance indicator, i.e., hours per what? Here, we will try to estimate hours per day and 20 m2 heated to 20 degrees Celsius. Some fictive data on the house are shown in table 7 and resulting time estimates for the 100 m2 building in table 8. Per 20 m^2 it is a fifth of this, i.e., 0.032 hours/day for the wooden construction and 0.364 for the concrete wall alternative. The buildings in the example contain identical amounts of insulation material, and the example shows that more than one DLS service can be assessed at the same time.

Table 7: *Characteristics of buildings with different walls.*

	Characteristic	
Feature	**Wood**	**Concrete**
Size of house, m^2	100	100
Wall height, m	3	3
Wall thickness, m	0.1	0.1
Material cost, €/m^3	850	240
Outdoor temperature, ºC	10	10
Heat conductivity, W/m, ºC	0.14	1.7
Energy for heating, kWh/day	40.32	489.6
Energy cost, €/kWh	0.1	0.1
Lifetime of building, years	100	100
Wall weight, kg	6000	27600

Table 8: *Time used for a 100 m^2 building.*

	Time use, hours per day	
Time indicator	**Wood**	**Concrete**
Wall price, (paid time)	0.010	0.003
Heating cost (paid time)	0.149	1.813
Maintenance (own time)	0	0
External costs (compensation time)	0.053	0.082
sum	0.16	1.82

4. Discussion

Measuring sustainable development as time for achieving a DLS will add analytic capabilities in several ways compared to current methods:

1. It will offer a way of aggregating all dimensions of sustainable development: environmental, social, and economic.
2. It will include unpaid time (in several disciplines considered as the 'informal economy'). Commercial actors have a profit-maximizing incentive to put as much work as possible on the customers. Travelling to large distant commercial centres, assembling products, filling in online forms, and do-it-yourself work are examples of unpaid time-consuming activities.
3. It is absolute, in the sense that individual time is limited. Current methods are all relative.
4. It is individual, allowing analysis of impacts on different population groups, like companies' customer groups and low-income groups.

Our method is limited to material wellbeing, and relies heavily on the work of Rao and Min. The uncertainty and subjectivity in formulating a "Decent Living Standard" is a limitation that we find party compensated by the relevance to our time and decision contexts. As pointed out by Rao and Min, updating, and developing the DLS concept further is needed.

The results from the examples analysed above, indicate that the external costs/time often is moderate compared to the time impact in the use phase of a product or service. As the determination of external costs is the most time-consuming step in the analysis, this step might be simplified by using generic data, at least in a first assessment. The use of generic data is already praxis in many environmental product declarations (EPDs). If shown to be of considerable magnitude, a deeper and more specific analysis can be performed, but if small, the results can be left as they are.

Using time as an indicator is attractive in the sense that it is independent of the income of a person. Poor or rich, all have 24 hours per day. But conversion of monetary values, e.g., environmental damage costs to individual time, needs attention. When estimating damage costs, the cost of labor must be specified. It is practical and seems fair to use the same cost of labor when converting impacts on labor to damage costs as when converting damage costs to compensation time. However, it is ultimately a moral decision whether all individuals shall carry the same compensation time per damage value, or not.

For individuals' surplus time to be an effective indicator in measuring progress in sustainable development, harmonization, software, and databases are needed. Experiences from development of LCA tools show that harmonization paves the way for development of software and databases.

The indicator we propose may be seen as an objective for the SDGs – "*Have as much time as possible to do whatever you want*" – and should resonate quite well with most persons' wishes. The proposed indicator seems most suitable for development of consumer products. Consumption is driving production and formulates its requirements on actors in the supply chain. In this case, it is mainly costs and external cost in the supply chain that is of interest to the actors in the consumption business. For policy, e.g., a tax on energy or a law, the indicator seems to be feasible to use if impacts on environment, paid and unpaid time can be estimated.

5. Conclusion

Individuals' surplus time when their basic human needs are satisfied is an indicator that is feasible to use for guiding sustainable development. However, two assumptions are needed to make it operable: 1) basic needs may be approximated by material requirement for a decent living standard and 2) capabilities to satisfy needs may be used as a proxy for needs satisfaction. The choice of services to ensure a decent living standard are dependent on present and near future living conditions, but this limitation is moderately decreasing its usefulness as the indicator mainly will be applied to present and future living conditions.

We conclude that surplus time maximization is an objective functional end point indicator of the SDGs, primarily for product development, but also useful in other contexts.

6. Acknowledgements

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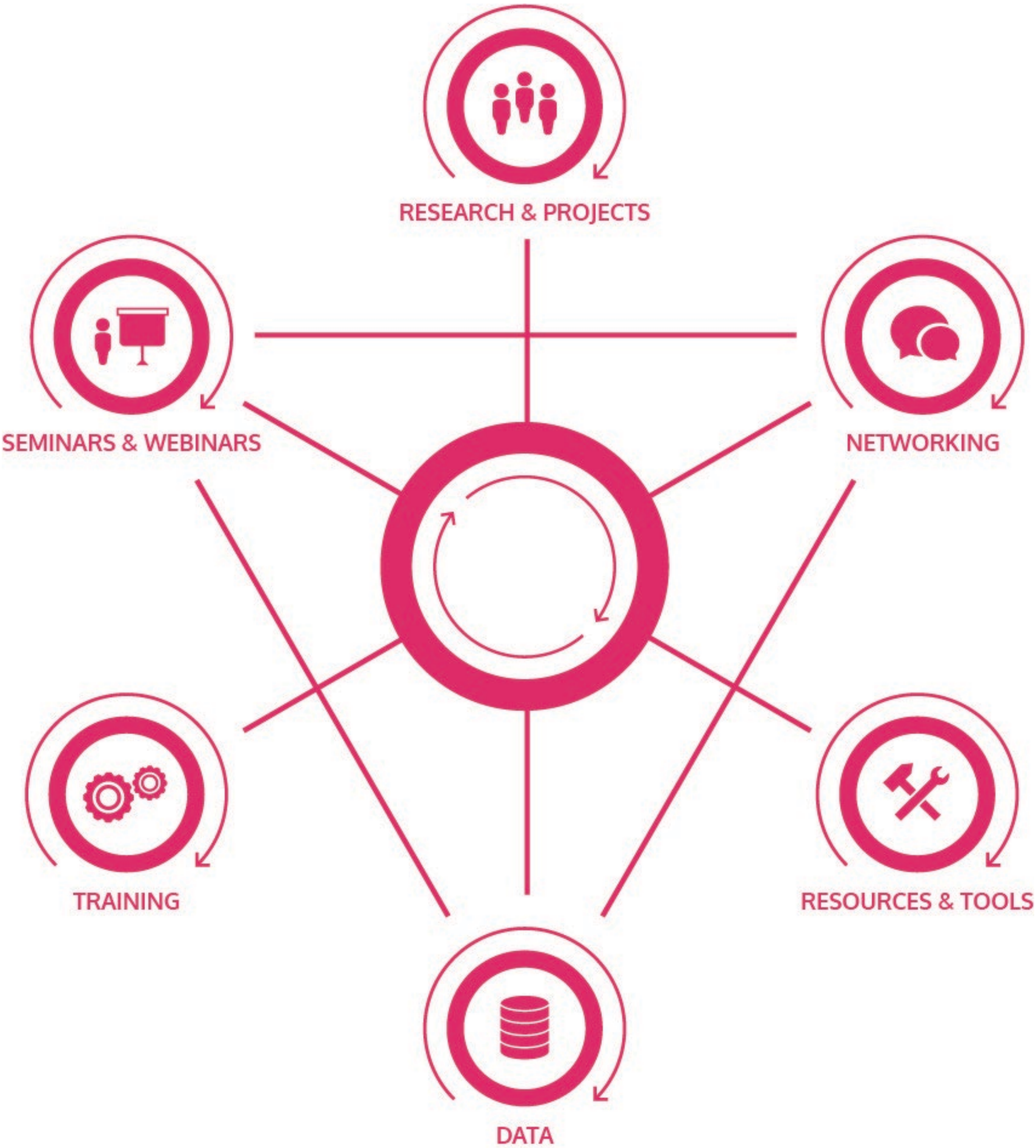

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