Fourth Generation Evaluation: Expanding the Evaluation Framework for Sustainable Design Projects

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Abstract: The evaluation methods currently adopted in design projects are traditional evaluation approaches based on a risk assessment approach. These methods can help quantify potential risks within the environmental, social or economic domain. However, in this approach it is difficult to obtain a holistic perspective of the design problem since the impacts in each of the domains are compartmentalized and the relationships among each are unknown or based on multiple value systems. Sustainable design requires a vision of solutions based on a temporal and spatial perspective that is predominantly long-term and global, so uncertainties are not easily addressed using traditional risk analysis approaches. This research proposes a shift in the evaluation approaches in design projects - a fourth generation evaluation method; a shift from an objective reality that is based on a linear traditional process of evaluation, to a reality that is constructed from the perspective of the stakeholders. This approach may provide the synergistic creative capacity of the design team instead of a compromise of each individual perspective. In this approach, both relevance and rigor must be reconciled in the design process.

Key words: Sustainable Design, Evaluation Method, Hermeneutic/dialogic methodology, Systems Thinking, Problem Framing.

1. Introduction

Evaluation is a form of inquiry [1]. Varying evaluation methods may differ in terms of the scope of the object to assess or the method used to obtain the evaluation results. For example, the scope at which a design problem is comprehended has an influence in the way in which it can be evaluated (see Figure 1). Evaluation conducted at varying scales of *problem perception* is related with the ways in which decisions are made and the scope at which consequences are perceived [2, p. 7]. Consequently, any of these varying perceptions have no bearing on the actual consequences of the problem; these variations in scale only allow a different perspective of the problem and a different work space available to the designer – which may be linked to the way in which potential consequences are comprehended by the design team.

In *Figure 1,* the various scales of approaches for understanding and evaluating design problems are presented. Design methods have been developed to help designers evaluate and conceptualize design solutions that may be more sustainable [3, 2, 4, 5]. Evaluation and conceptualization approaches in a context of sustainable design vary in terms of assessment format: checklists, guidelines, principles, analytical tools [6, 7]. Checklists are often

used by designers to guide them in the positioning of their product or service within the proposed framework [6, 7]; they help the designer converge to a solution of a given problem. Checklists may also help designers understand if a product or service abides by the recommendations provided [6, 7].
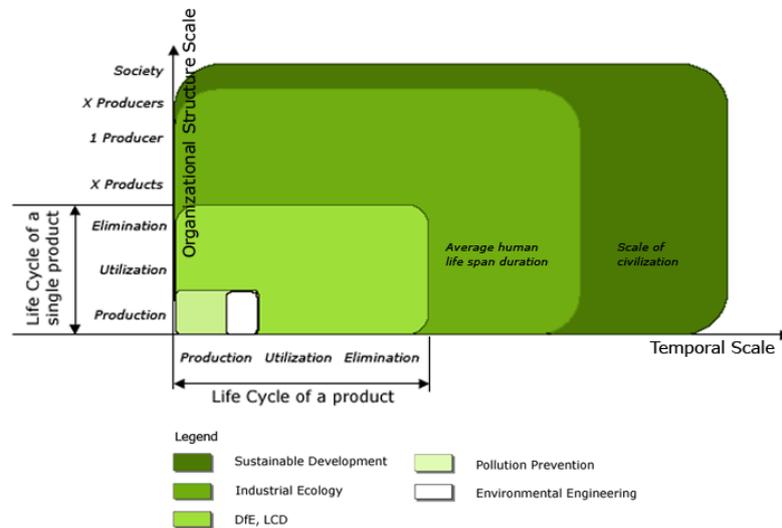

Figure 1: Various scales of problem vision [based on: 8]

Analytical tools are used to measure environmental or social impacts or benefits. These tools seek to provide an objective form of analysis so that an interpretation of the inventory of the impacts may be provided. Such analysis tools are often conducted by third party experts in order to maintain the required level of objectivity. The recommendations by the group of experts are used by designers so that they may be addressed during the conceptualization of the new product or service, yet are not very useful in supporting idea generation [9].

Principles are also very pertinent in the convergence of a design problem, but similar to the aforementioned approaches, they do not adopt a design approach towards evaluation – meaning, on their own, they may not allow an initial process of divergence [9]. Krippendorff [10] states that designers and scientists work in incommensurable paradigms, where efforts to search for commonalities may not serve either. So, how can they work together, when their methods of working reside in different paradigms? This is why a constructivist paradigm for evaluation in a context of sustainability, based on a hermeneutic/dialogic methodology where the findings of the process are co-learned presents a fitting approach. A hermeneutic/dialogic methodology for evaluation will necessarily include both quantitative and qualitative elements, since knowledge from a plural set of actors will be obtained. This will be presented in this paper.

2. Addressing Sustainability through Design

In a context of sustainable design, it is important to adopt an attitude that seeks to transcend enough boundaries to enable transformational. Methods or strategies of evaluation and conceptualization that may encourage this type of thinking are needed. A strategy like efficiency refers to getting the most products or services for the least impacts [11], and is fundamental for eco-design. In fact, industrial development which adopts a mode of conventional capitalism accepts the idea of amassing as much financial capital by liquidating the natural capital used; so, the most output for the least input, which is essentially, efficiency [12, 13, 14]. So, this strategy alone is not enough for moving beyond the crisis we are faced with. On the other end of the spectrum, it is

incomprehensible within current society to address sustainable design through a philosophy of non-consumption and therefore non-design, since the repercussions on the economy and therefore on societies will be catastrophic. In this perspective then, according to Chapman and Gant [15, p. 7], "*The aim therefore must be to design in a way that promotes consumption models of long-term sustainability.*"

Krippendorff [10] points out that there are two separate methods of design: a technological design and a human-centered design, where human-centered design is based on second-ordered understanding. It is important to highlight that design requires both, so that human-centered design must also be based on technological aspects. So, it is essential that both scientists and designers can work together, since they each can contribute in varying ways to the design problem in order to address the complexity of design problems in a context of sustainability. Krippendorff [10] states that designers must adopt a second-order understanding for design in the post-industrial age. Second-order understanding refers to an understanding of someone's understanding.

In this sense, the knowledge that is created through second-order understanding is a collective, hermeneutic and dialectic. In fact, such an approach will help the design team, made up of tech nologists, designers, and community members to understand, contextualize, and possibly, challenge the given design problem [16, 17, 18]. One of the difficulties lie in the ways in which these members comprehend and assimilate each other's issues, claims and concerns into their own perspective of the design problem. Methods of evaluation then become a fundamental element for sustainable design, especially because evaluation is intrinsically linked to the process of conceptualization [19].

Consequently, the more the process of evaluation or problem-solving in design are disconnected from the complex real world phenomena, and oriented by specialists and experts, the larger the extent of interrelationships within this complex problem which are ignored in developing alternatives [20]. This evasive approach to problem solving unlocks the possibility of unintended consequences [20] - an understanding of the complexity of the phenomena has been ignored and therefore the proposed solutions become inconsistent with the original problem. In this case, the reductive methods are limiting and therefore our attention is drawn to a spectrum of non-reductive methods for assessment. Therefore the need arises to consider a shift in paradigm for evaluation.

2. The Shifting Paradigm of Evaluation Methodologies

Acccording to Guba and Lincoln [1], evaluation is a form of inquiry whose focus is either some program, process, organization, person, etc. and which results in a *merit* and/or *worth* judgment [1]. According to Trochim [19], evaluation is the systematic acquisition and assessment of information to provide useful feedback about some object. In general, the goal of evaluation is to provide some feedback regarding that which is evaluated, and therefore, it can influence decision making or policy formulation [19]. There are various generations of evaluation. The shifting paradigms of evaluation as defined by Guba and Lincoln [1], have followed the shifting paradigms in research epistemologies. This is interesting, since the shifting paradigms in research epistemologies, are a precursor, to the shift in design theory and thinking [21, 22, 23, 24, 25, 26, 10].

2.1 Evaluation based on Measurement, Objective and Judgment (First Three Generations)

There have been three generations of evaluation which are predominantly based on a positivist paradigm [1].

They a re re ferred t o as: *measurement* ba sed, *objective* (go al) b ased and *judgment* base d [1]. In the first generation, re ferred t o as *measurement* based, th e evalu ator is tech nical. Quantitative in struments of measurement are used in this approach. An example in the education system - students are evaluated in terms of their capacity to repeat the information they are taught. The evaluators were essentially evaluating memorization capacity [1, 27]. This generation of evaluation methods can be seen to fall into what Trochim [19] refers to as the *scientific-experimental models*. The se are the m ost historically dom inant evaluation strate gies. T hese evaluation approac hes take t heir values a nd m ethods from the sciences. They value im partiality, accuracy, objectivity an d t he val idity of t he i nformation ge nerated [1 9]. An e xample of a fi rst gene ration evaluation method is the business financial statement; it provides a measure of the organization's financial position.

Second generation e valuation ap proaches a re re ferred t o a s *objective* ba sed. He re, usi ng a n e xample fr om t he education system again, t he evaluator de scribed the strengths and weaknesses with re spect to gi ven objectives from a gi ven curriculum [1, 27]. An e xample of an ev aluation m ethod ba sed on o bjectives i s C ost-Benefit Analysis, since the main goal is to verify if an objective has been attained. Six-Sigma[1] can also be considered a second generation evaluation method as are many of the multi-attribute analysis methods.

Third generation e valuation methods, referred to as *judgement* ba sed app roaches, the evaluator is a judge. The main qu estion in th is appro ach is whether the objectives are worthwhile, and not so much are the objectives achieved [1, 27]. The role of the evaluator is to judge merit and worth on the basis of standards and models [1, 27]. The standards upon which judgments were made, was born in this generation of evaluation.This generation of eval uation approaches ca n be see n to fall in to what Trochin [19] refers to as *management-oriented systems models*, where depth and breadth in evaluation are the emphasis. In this mode, evaluation falls within the larger framework of organizational activities [19]. Delphi[2] survey method is an example of third generation evaluation. It is a decomposition techn ique for i dea generation and selection [28]. Ot her ex amples are MCDA (M ulti-Criteria Decisi on Analysis) methods, C PM (C ritical Pa th Method) and PERT (Programme Evaluation Re view Technique)[3].

2.2 Evaluation based on a Hermeneutic/Dialectic Process (Fourth Generation Evaluation)

Fourth generation ev aluation (FGE) is d efined by a shift in ep istemological po sitions, fro m a p redominantly positivist to a con structivist p aradigm [1 , 27]. Th ere are two m ain p hases of a co nstructivist ev aluation; discovery a nd assimilation. T he discovery phase is the phase where the evaluator desc ribes '*what is going on here*' – here meaning the process, program, person, etc. that is being evaluated. The assimilation phase is where the evaluator incorporates the new discoveries into his/her existing knowledge regarding the object to evaluate.

As Piaget [29] describes in his constructivist learning process, the assimilation process is one of evolution. This is where the participants interact with their environments based on three fund amental reactions: the acquisition

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[1] Six Sigma seeks to identify and remove the causes of defects and errors in manufacturing and business processes. It uses a set of quality management methods, including statistical methods to arrive at a result (source: http://en.wikipedia.org/wiki/Six_Sigma).

[2] Delphi is a decomposition technique for idea generation and selection. A Delphi survey is a structured group interaction process that is directed in "rounds" of opinion collection and feedback. Opinion collection is achieved by conducting a series of surveys using questionnaires. The result of each survey will be presented to the group and the questionnaire used in the next round is built upon the result of the previous round (source: http://www.ibiblio.org/fosphost/IFHOSP/ExplainDelphi/whatdelphi.htm).

[3] CPM and PERT are project management techniques, which have been created out of the need of Western industrial and military establishments to plan, schedule and control complex projects. (source: http://www.interventions.org/pertcpm.html).

of information, the release of information and the total or partial capture of these [30]. The first two are a process of specialisation (or discovery with respect to the FGE), and the last is the evolution of learning through memorization, apprenticeship, and complexification [30] – which represents the assimilation process in FGE. This constructivist learning process is a fundamental element of FGE [1].

This is the most appropriate method to develop viable and acceptable solutions that reflect the value-oriented views of the stakeholders [1]. This is important when considering the plural views of claims, concerns, and issues regarding a process, program, or organization. This axiological approach is in direct contrast to the normative approach adopted in 1st, 2nd, and 3rd generation, so an opposition of ideologies exists between FGE and the first three generations.

One of the most important characteristics of FGE approach is its capacity to adopt courses of action based on the formulation of constructions. In particular, this represents an approach where the group of stakeholders sees the adequacy, the relevance and the continued modifiability of such actions. So the evaluations are more socially and politically sensitive [1].

This constructivist evaluation approach is based on three basic assumptions: ontological, epistemological and methodological [1]. The basic ontological assumption is relativism – sense making that organizes experience so that it is comprehensible and explainable [1]. There is no 'objective' truth in this ontology – but local and specific constructed realities. The epistemological assumption is transactional subjectivism [1]. This refers to the fact that the realities are co-created and that truth is derived from the sense-meaning drawn from experiences based on the level of sophistication available to each of the individuals engaged [1]. The methodological assumption is a hermeneutic/dialectical process. This refers to a process where first each individual involved must first uncover and find meaning from each of the other presented perspectives, and then compare, contrast and confront each of these to result in courses of action [1, 27]. There is an interpretivist, emergent quality in this methodology [31, 32, 1]. The main goal of such an evaluation approach is an understanding and reconstruction of plural views, aiming toward open-ended consensus and/or action [1].

This generation of evaluation methods can be seen to fall into what Trochin [19] refers to *qualitative/anthropological models and participant-oriented models*. Qualitative/anthropological models emphasize the significance of observation, the need to maintain the phenomenological aspect of the evaluation context, and the value of subjective human interpretation [19]. Participant-oriented models underline the importance of the evaluation participants and the value of their knowledge, especially clients and users of the object to evaluate. The main advantages to such an evaluation approach, regarding the negotiation process of the stakeholders, are [31, p.342]:

> "*(1) attempts to help them reach consensus about their reality or to recognize discrepancies; (2) is educational because it provides stakeholders with the opportunity to incorporate others' perspectives of the construct into their own; and (3) is empowering because the entire process is built on negotiated stakeholders' constructions of the evaluand*".

The basic process of FGE can be defined as [31, 1]: (1) the identification of stakeholders; (2) understanding and comprehending stakeholders' claims, issues and concerns about the construct of the problem to evaluate; and (3) seeking consensus among stakeholders via discussion, negotiation, and exchange. It is during the last phase where the opportunities for co-learning and co-creation arise. If controversies arise, or there exist issues or

concerns that cannot be resolved, these will be highlighted for possible later resolution [32, 1]. This results in a fruitful exchange among the participants, where they jointly produce a conceptual map of the problem [32].

3. Extending the Evaluation Framework for Sustainable Design

To embody the complexity of the environmental and societal implications of design projects, an evaluation process that transcends traditional risk assessment methods for design is necessary. Traditional evaluation methods (based on ideas such as cost/benefit analysis) are of limited use for design practice, especially when used on their own. Such tools would greatly benefit from an integrated approach to assessment. One of the reasons for an integrated approach is that it would allow a deliberation resulting from the new knowledge provided by such tools, but also, on a qualitative level, from the concerns, issues, and claims amongst the stakeholders of the design project – so both technical design as well as human-centered design. This may expand the evaluation framework for the design team, enabling them a further exploration of alternative design solutions, and more importantly those that may transcend boundaries on an organizational, social, cultural, or economic level.

3.1 The Pertinence of a Hermeneutic/Dialectic Evaluation Process for Sustainable Design

Because of the impossibility of ignoring contradictions, uncertainty, and disorder in the outcomes of design projects, a complex method based on the literature of Edgar Morin [33, 34] is promising. It can address the general problematic of knowledge with respect to the human sciences and may be adapted to the inquiry process of design. Complex thinking allows designers to relate (contextualize within a broader vision) antagonistic concepts and seeks to take uncertainty into consideration by integrating chaos and chance in the synthesis and analyses of the design problem.

FGE is a constructivist evaluation approach. Constructivist evaluation is a process for conducting evaluation that must satisfy two fundamental conditions [1]: (1) the evaluation is organized such that the claims, concerns, and issues of stakeholders are assimilated into the process; and (2) it adopts the methodology based on a constructivist paradigm. A constructivist methodology in this perspective will require as a minimum a hermeneutic/dialectical evaluation process. Therefore the epistemological basis of the methodology is transactional subjectivity – co-created findings [35, 36, 1].

FGE requires a participatory approach to evaluation, where the knowledge is not only shared, but the possible solutions and courses of action to undertake are co-created within the stakeholder group. Therefore, this approach requires a process of co-learning and co-creation and is concerned with change, and therefore based in action. In fact, Van Der Ryn and Cowan [2] explain that the most powerful technique available for sustainable design is an integrated design process since it brings together project participants. A shift from compromise to collaboration occurs when adopting such a process.

3.2 The Integrated Design Process as a Design Method for Adopting FGE

Transformational leaps towards sustainability require such deliberation amongst the stakeholders within the design process. A serious consideration of these dimensions may constitute an expanded evaluation approach grounded in a complex vision of the world. One such method to enable extending the evaluation approach is

the Integrated Design Process[4] (IDP). IDP ideally provides a framework for a trans disciplinary approach for design and therefore provides a promising basis for the type of knowledge sharing integral to this expanded evaluation method.

One of the main differences between traditional design teams and IDP teams is their organizational structure. A conventional design team adopts a hierarchical organization, whereas an integrated design team adopts an interlinked team structure [18]. Because of the fundamental organizational differences between traditional and integrated design processes, the involvement of the stakeholders also differs significantly, as Figure 2 illustrates. In an IDP, the stakeholders of a design project are ideally involved throughout the design process. This is in contrast to traditional design processes, where each stakeholder works individually, so that the entire process is optimized.
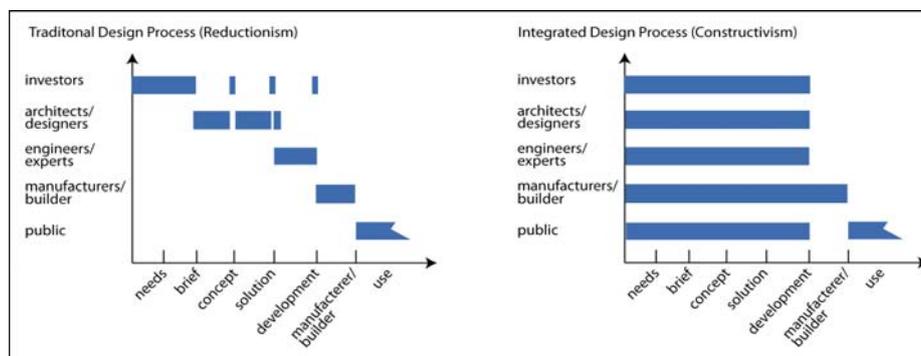

Figure 2: Comparison between the level of involvement of stakeholders in traditional and integrated design processes [based on: 38, 16, 18, 39].

In general, the IDP is based on the facilitation of dialogue among stakeholders who bring different insights to bear on complex issues in a design project [16]. It allows the issues to be exposed, and provides a space for dialogue among stakeholders so as to avoid irreversible decisions with incomplete information.

IDP provides a promising framework for an expanded form of evaluation based on FGE. In addition, this paper proposes that if FGE methods are adopted in an IDP, in a context of sustainable design, this may have added benefits regarding the creative outcomes of the design solutions based on the synergies resulting from the deliberation amongst stakeholders in the design team. Therefore, this upcoming research will examine to what extent IDP, as employed in practice, succeeds in transdisciplinary knowledge sharing, relies on FGE, and contributes to an understanding of complex environmental and societal implications of the project.

4. Discussion

FGE merits to be integrated in the design process, because the decision support it affords the design team in situations of uncertainty and contradiction can encourage a mode of discourse and deliberation that may allow the construction of alternative scenarios in order to satisfy the concerns of the stakeholders and therefore can

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[4] IDP is based on the facilitation of dialogue among stakeholders who bring different insights to bear on complex issues in a design project [**16**]. It allows the issues to be exposed, and provides a space for dialogue among stakeholders so as to avoid irreversible decisions with incomplete information. The main characteristics of an IDP are [**16**]: holistic or systemic thinking of the problem; inclusive process of dialogue; iterative decision process – a co-learning process; collaborative; goal-driven; Synergistic; structured to deal with issues that consider the non-reversibility of decisions; clear-decision making for making decisions and resolving critical conflicts; non-traditional and traditional expertise involved; whole-building budget setting [**16, 37, 17, 18**].

address the common-good.   What can FGE present to a design project that is not already present when adopting any of the first three generations of evaluation methods?

First, in its essence, FGE presents an alternative to traditional judgment based evaluation that can help guide decisions based in action – it is essentially an approach for evaluating problems that are based in contradiction and ambiguity. So it is best to apply such an evaluation approach at the beginning of a design project. The evaluation in a traditional design process often occurs at the end of the detailed design phase [based on methods such as those proposed by 40, etc., 41]. If there is some evaluation at the beginning of the design project, it is to set benchmarks of existing products so as to present the objectives for optimization.   Having the ability to evaluate the project itself, allow the design team to question the relevance of the problem being addressed in a context of sustainable development is not typically done. An evaluation during this phase would help reveal any unforeseen outcomes.

A reflective approach as defined by Edgar Morin [33, 42, 34] is interesting to adopt at this early conceptual phase. Unlike current sustainable assessment methods, the method as seen by Edgar Morin proposes more of a way to reflect and adopt ways of looking at new problems differently (descriptive), rather than of defining a new way of looking at problems (prescriptive). Therefore meta-evaluation methods for addressing the dialectical nature of problems within a group, ways to assimilate the knowledge of all those involved in one's own perspective, etc. are available when adopting this world view.   Many of the problems that face humanity, according to Edgar Morin, are based on the idea of individualism, and the lack of inter-dependence among individuals and between individuals and their environments [42].

Second, the problem space is expanded when FGE is adopted. This is mainly due to the fact that when the claims, concerns and issues of each are sought to be assimilated by the other stakeholders in the team, then the problem space is inevitably expanded.   In addition, in such an evaluation approach, the system from which an understanding of the problem is sought is not a closed system. It is open and flexible based of the discursive interrelations of the stakeholders.

Third, a set of indicators to assess, not the necessity of the product, or the product longevity but an assessment of the way in which the assessment took place would help the design team understand how well it took into consideration the views of the stakeholders into account, or how they assimilated the considerations of the stakeholders in their own reflections. This new set of indicators therefore represents a meta-evaluation of the design evaluation process. The indicators, the stakeholders, and the level of participation necessary would be selected on a case-by-case approach – but the method would remain fixed.

Finally, a set of indicators that would help assess both the contradiction and uncertainty inherent in the design project would be proposed. This would be based on values of the stakeholders, and not only on international norms or on statistical processes. This is where the acceptability of the project and the various proposals would be challenged, and therefore a collaborative effort is necessary in this approach, as it based on the plural views of the stakeholders. The criteria used in this assessment may be constructed during the discourse process itself. So again, it will not be the assessment of the indicator, but the establishment (exploration) and assessment (resolution) of the indicators.

5. Conclusion

In conclusion, there is a fundamental divide between sustainable design practice and design theory – a cultural and ethical separation between the theories developed, and the values of clients, developers, or governments. Designers have the potential to make quantum changes because of their position to conceptualize *that which is not yet* [21, 22, 43], and therefore their intentions have much power, if and when manifested. The status quo must ideally be critiqued so that the potential for a different way of living, a different world that we are all responsible for. However, this cannot be done when the framework is prescriptive, as this represents the status quo. A framework for sustainable design does not refer to the prescription of what is wrong or right, but instead is a method for designers to enable them to comprehend what the common-good is. A necessity to go beyond prescriptive approaches arises, towards methods that are descriptive and axiological – therefore a merging of rigor and relevance in the design evaluation process [44].

6. Acknowledgements

7. References

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