The ECC Methodology for Architecture Design Theory and Practices Research

Fathi Bashier
Wollega University, Nekempte, Ethiopia
fathi.b@wollegauniversity.edu.et

Abstract. This study proposes the ECC methodology to improve design practices systematically. The article describes the research strategy called the evaluation-creation cycle (ECC) the foundation of the ECC methodology. Recent studies showed that a failure of desired outcomes is often a result of a failure of to understand existing practices. This suggests that improving design requires more than a theory of what exists, it also requires using this understanding to change the design process to one that leads from the existing to the desired through the evaluation-creation cycle approach. This requires understanding the relations of knowledge creation through the analytic and the synthetic practices within the design process, as well as the relations between the design process and the outer design context. The study draws insight from the Renaissance theory in order to obtain understanding the development of descriptive ‘knowledge of design’ focused on increasing design understanding, and based on this prescriptive ‘knowledge for design’ providing design support are created. This has informed the development of the evaluation-creation cycle (ECC) strategy and the ECC methodology based on it. The aims of the ECC methodology are the evaluation of existing practices and the principles that support them, and based on this the development of understanding with which to change the current situations into preferred ones. In this article the evaluation-creation cycle (ECC) approach is described and the ECC methodology based on it introduced, and the way in which design principles can be developed, improved and used to predict desired outcomes is discussed.

1. Introduction
This study proposes the ECC methodology to improve design practices with which to change existing situations into desired ones. The article describes the research strategy called the evaluation-creation cycle (ECC) approach, the foundation of the ECC methodology.

Recent studies, as well as empirical findings in this research, both showed that a failure of desired outcomes is often a result of a failure to understand existing practices and the design principles they are based on. This suggests that, changing existing situations into the desired ones requires more than a theory of what exists, it also requires using this understanding to change existing into desired situations [1]. This requires understanding the relations of knowledge creation through the analytic and the synthetic practices within the design process, as well as the relations between the design process and the outer design context.

The study draws insight from the Renaissance theory in order to understand the relations of knowledge creation within the “inner” design process environment, and between the ‘inner’ design
process and the “outer” knowledge environments. This has led to understanding the development of descriptive ‘knowledge of design’ focused on increasing design understanding, and based on this prescriptive ‘knowledge for design’ providing design support are created. This has informed the evaluation-creation cycle (ECC) and the ECC methodology based on it, which is now being developed and used in the studio. The aims of the ECC methodology are the evaluation of existing practices and the principles that support them, and based on this the development of understanding, which can be used to develop improvement measures to achieve the desired outcomes.

This article aims to introduce the ECC methodology and to document the implementation of the research procedures. The students have been engaged in the evaluation of existing cases of design problems that were selected according to a set of priorities based on professional interests. They are now creating explicit understanding based on the data analysis, which will be used as basis for developing and testing design improvement measures in a later stage of the research. This article relies mainly on data from the literature, and the empirical findings of the previous evaluation study that is reviewed in this article, as well as new information that is already coming in from the current research. In addition, the article relies heavily on the author’s own experience in teaching, preparing the ECC methodology and monitoring the research implementation.

The research procedures are proposed to iterate through the analytic evaluation phases and synthetic creation phases of the ECC methodology in accordance with design science methods at two levels: theoretical and empirical. The research in the theoretical part is directed towards reflection on existing practices and obtaining descriptive understanding, ‘knowledge of design’, which can be used as basis to develop prescriptive design support knowledge, ‘knowledge for design’, in order to predict the desired outcomes and to test them. At the empirical level, the design support developed at the theoretical level will be used to aid predicting and testing the desired outcomes through experimental research-based design work in the studio.

The focus of the present article is on the first part of the study, the theoretical research, in which the evaluation-creation cycle (ECC) is described and the ECC methodology based on it introduced, and the way in which design principles can be recovered from existing design experience, adapted to fit changing knowledge environment, and used to predict desired outcomes is discussed.

2. Literature review
Many theorists noted that design science seeks to understand the world in order to act on it. Friedman [2] writes that design “must rest on effective understanding of the world itself”. Simon [3] describes the fulfillment of purpose in adaptive systems, the desired outcomes, as the interface between the “inner” environments of the design process, and the “outer” environment in which a desired outcome develops and operates. Hillier [4] noted that “Any theory about how we should act to produce a certain outcome in the world must logically depend on some prior conception of how the world is…” In much the same way, Friedman [5] recognizes the importance of understanding the linkages between designed processes or artefacts and the larger context within which they are created and found. He argues that the failure of design outcomes results most often from “…a failure to understand the linkages between designed processes or artefacts and the larger context within which they are created and found [5]”.

All three theorists recognize the relations between the desired outcomes and the analytic understanding they are based on. Although theorists generally maintain that synthetic creation depends on the analytic understanding of design experience as Hillier [4] suggested, they fail to explain how descriptive understanding provides basis on which prescriptive knowledge develops. Hillier characterizes architecture design theories, as analytic-synthetic complexes in which synthetic creation is based on the analytic understanding of design experiences [4]. However, the analytic-synthetic
theory he suggested doesn’t explain the way in which knowledge creation through the analytic-synthetic relations takes place.

The study draws insights from the Renaissance theory of proportions to improve our understanding of contemporary design theory. In the Renaissance, design theory was a scientific theory guided by “The ancient idea that the world is a mathematical creation, and that, in order to participate in that harmony, the things we make must obey the same mathematical laws [6]”. We know from the writings of Vitruvius and his followers in the Renaissance that mathematical proportions had since the antiquity been used to aid designing in harmony with the laws of nature [7]. According to Alberti in the 15th century [8], the ancients learned through observation of nature and sought to apply this knowledge into architecture. They captured the laws that nature uses to produce things and translated them into design principles.

In the Renaissance, the classical design principles were rediscovered. The Renaissance, architects used mathematical proportions to prescribe the classical design principles in order to produce forms and shapes of buildings in harmony with the laws of nature. This is the basis of design science as appears in the writings of Simon and other modern-day theorists, and used in this study as basis of the evaluation-creation cycle approach.

This study is concerned with understanding knowledge creation through the relations of the analytic-synthetic practices within the design process and their relations with the outside world, as well as understanding the role design principles play in knowledge creation. We learn from the Renaissance that design principles provide linkages between design practices and the large design context in which design develops and acts.

The insight from the Renaissance theory of proportions has served understanding how design principles are produced and used through the interaction of the analytic-synthetic relations. Design principles determine knowledge creation through the analytic-synthetic relations within the design process, as well as the relations between the ‘inner’ knowledge creation and the ‘outer’ design experience environments. Design principles can be perceived as the interface between knowledge creation practices within the ‘inner’ design process, and the ‘outer’ design experience environments.

3. Reviewing the ‘Design practices evaluation’ study
The present study builds on a previous study of design practices evaluation recently conducted in the studio [9]. In this section the previous evaluation study is reviewed and more analysis added. Several architects were surveyed. The analysis of the data used by the architects to address the various design issues has indicated two types of knowledge that most architects failed to develop. The first is the analytic knowledge of practices evaluation and the principles upon which those practices were based.

The architects’ survey showed that most participant architects failed to analyse existing practices and to produce descriptive knowledge to explain the principles upon which those practices are based. The obvious reason is that the architect’s relations with designed artefacts usually ends when construction is completed or on the completion of the drawings in many cases. As the survey showed only 10% of the architects who participated in the survey had acquired data from the evaluation of design outcomes or even participated in any design evaluation. Architecture education often gives little attention to research, writing and knowledge communication, as a result, “where design knowledge must be codified architects have strong preferences for visual over written communication”, the RIBA stated [10].

The other type of knowledge that architects generally fail to produce, involves explicit design decisions and the design support knowledge to achieve desired outcomes. This article is concerned
with understanding the linkage between these two forms of knowledge, which many of the surveyed architects failed to develop: the descriptive ‘knowledge of design’, the outcome of existing practices evaluation; and the prescriptive design support ‘knowledge for design’ based on the analytic. The work of the surveyed architects showed the failure to understand the linkages between design practices and the larger context within which practices were created and found as Friedman [5] suggested. This explains why a failure to understand existing experiences and the principles they are based on often leads to a failure of desired outcomes as Friedman [5] suggests.

The insights from the Renaissance theory have enabled the study to develop understanding the relations of knowledge creation through the analytic-synthetic practices within the design process and their relations with the outside world, as well as the role design principles play in knowledge creation. More about how the evaluation process can provide analytic basis for the prescriptive knowledge to develop and for the theoretical foundations of the evaluation-creation cycle, will be discussed in the following section of the article.

4. The evaluation-creation cycle (ECC)

Recent studies, as well as empirical findings in this research, both showed that a failure of synthetic creation is often a result of a failure of analysing existing practices and understanding the principles on which those practices are based. This suggests that improving design requires more than a theory of what exists, it also requires understanding what would be desirable and how to change the design process to one that leads from the existing to the desired through the evaluation-creation cycle. There is no theory at present exists that could explain knowledge creation through the analytic and the synthetic relations within the design process, and their relations with the design experiences context. Contemporary design theories fail to explain the role design principles play in providing linkages between the practices of knowledge creation within the inner design process and the outer design experiences environments.

We learn from the Renaissance theory that design principles could be extracted by analysis from existing design experiences and applied to new design work. Design principles were historically used, and can be used today, as the measures with which analytic knowledge can be determined and against which synthetic knowledge should be judged. This is the basis of what Hillier [4] refers to as the double nature of architecture theories, which he describes as “analytic-normative complexes [4]”. In these two aspects of architecture theory, the first deals with the world as it might be, the second with the world as it is. How may there be theories of architecture “which are at once creative and analytic”. The answer is: “Scientific, theories are arrived at through the examination of the world as it is. But it is exactly the theoretical understanding of the world as it is that opens up whole realms of new possibilities that do not yet exist” Hillier writes [4].

The relations between design theories and the analytic-synthetic practices were discussed by Blessing and Chakrabarti [11]. In their discussion of the relations between the analytic understandings and the prescriptive knowledge based on them, Blessing and Chakrabarti refer to the basis on which prescriptive knowledge depend on the descriptive theories without mentioning the role of design principles. Chakrabarti (2011:250) writes that design theories have descriptive and prescriptive goals, “descriptive theories provide the basis on which prescriptive design support methods and tools are developed” [11].

To explain the descriptive basis on which the prescriptive design support is developed, as Chakrabarti suggested, requires understanding how the design principles provide linkages in the relations of knowledge creation within the design process, and between the design process and the outer design experiences context. This supports the above discussion about Hillier’s analytic-synthetic theory. Describing the role of design principles in the relations of knowledge creation between the
inner design process and the outer design experience environments, complements Hillier’s explanation of the relations between the descriptive and the prescriptive knowledge.

Based on the Renaissance theory, design principles may be perceived as the rules that determine the characteristics of the knowledge that develop through the analytic and the synthetic practices. First, the analytic practices develop descriptive ‘knowledge of design’, and based on this prescriptive ‘knowledge for design’ shall be developed through synthetic practices. Design principles are produced and used through the analytic and the synthetic practices. They can be extracted by analysis from the evaluation of existing design experience and then adapted and prescribed to new design works. This is the goal of the evaluation-creation cycle through which design principles could bridge the gap between theory and practice research.

The evaluation-creation cycle is consistent with design science as defined by Simon [3]. He defines design in terms of what designers do “Everyone designs who devices courses of action aimed at changing existing situations into preferred ones [3]”. This definition means that changing existing situations into preferred ones, requires understanding exiting situations and the actions that lead from existing to the desired ones. This is the basis of the evaluation-creation cycle (ECC) upon which the ECC methodology is founded.

The ECC Methodology is perceived as acyclic process in which the interaction between the analytic and the synthetic practices can lead to cycles of evaluation and creation, through which existing experience is evaluated to produce knowledge, and knowledge is used to improve design. In this process design knowledge is produced and used through reflection and synthesis involving different modes of conversion between tacit and explicit knowledge. Nonaka [12] identifies “four different patterns of interaction between tacit and explicit knowledge. These patterns represent ways in which existing knowledge can be converted into new knowledge” [12].

In this study we can identify two modes of knowledge conversion that are central to the evaluation-creation cycle (ECC) approach. One is the conversion of the tacit knowledge produced by reflection on existing practices into explicit understanding that can be used to improve design practices. The other pattern involves conversion of explicit understandings produced in the theoretical part of the methodology into explicit design support principles, methods and tools. The students will be experimenting with the process of converting design knowledge into explicit design decisions, and actions to achieve the desired outcomes. The process iterates through more cycles of evaluation and refinement of explicit design understandings and design support based on them. The ECC methodology will be used and verified in the empirical part of the ongoing students’ research work in the studio, which will be documented in a future article.

5. The ECC methodology for design practices research
Design research and theories may be about design practices, about the outcomes or about both [13]. The study proposes the ECC methodology to improve design practices. This section briefly describes the procedures through which the ECC methodology will be used. The purpose of this article is to anticipate how the prescriptive part of the ECC methodology will work.

The ECC methodology will be used to integrate design practices experience into knowledge through the evaluation-creation cycle, which as Kolb [14] suggests, is “the process whereby knowledge is created through the transformation of experience [14]”. This is a process of reflection and extraction of tacit knowledge embodied in buildings or design drawings. The evaluation process involves converting tacit knowledge into explicit understanding that can be used to develop explicit design support in the empirical phases of the study. This requires more than a theory of what is, it also requires using theory for predicting and testing what would be desirable.
The ECC methodology will be used in the study to guide knowledge creation in accordance with design science methods through the analytic and the synthetic practices of the evaluation-creation cycle at two levels: theoretical and empirical. This article is focused on the theoretical part of the study. Research at the theoretical level is focused on the evaluation of existing design work, the practices and the principles that support practices, and providing descriptive theory. The importance of theory is that it not only aims at describing practices and explaining the design principles that support them, but also at using this understanding, as Blessing and Chakrabarti [1] suggests, in order to develop prescriptive design support in the form of enhanced principles, methods and tools to improve design in the synthetic part of the methodology.

The evaluation process is a scientific approach based on observation and reflection. The process involves analysis of several individual cases of the same class of building types that could lead to discover supporting principles. These represent a set of priorities that good design may comply with in order to produce architecture in conformity with human values. The students are now engaged in classifying the data to measure the quality of design outcomes based on their ability to meet the prevailing technological, economic, and environmental values of our time.

This process should lead to finding patterns in the data that could explain the reasons why certain principles underlying existing practices contribute to or prohibit success, and based on this enhanced design support through adaptation can be developed and future performance of design decisions predicted.

6. Conclusions
The lack of integrated methodology for architecture design practices research has led to the emergence of two separate approaches. Blessing and Chakrabarti [1] write that two streams of research have evolved: one is focused on increasing design understanding, and the other on developing support for designers. As a result, the separation of research to develop ‘knowledge of design’ and research to develop ‘knowledge for design’ often leads, as the empirical evaluation in this study showed, to a failure of changing existing situations into desired ones.

Recent studies, as well as empirical findings in this research, both showed that a failure of the desired outcomes is often a result of a failure of analysing existing practices and understanding the principles on which those practices are based on. This suggests that changing existing situations into preferred ones requires more than a theory of what exists, it also requires understanding what would be desirable and how to change existing situations to the desired. In order to implement this policy effectively, an integrated approach for theory and practice research must be developed.

Our attempt to resolve the lack of integration in design research has been to propose the ECC methodology in order to address both aspects of theory and practice through the evaluation-creation cycle. The ECC methodology is an integrated methodology, which is proposed to bridge the traditional gap in research between theory and practice- between sense making and form giving as Sanders [15] writes- based on design science method.

The ECC methodology combines the traditions of scientific method and the design process methods. Whereas, as Aburamadan and Trillo [16] suggest, design science goes further than describing and explaining how things are, by seeking change and enhancing design support to aid desired outcomes and predicting their future performance. The ECC methodology aims not only to develop understanding of existing practices and the supporting principles, but also to use this understanding in order to prescribe enhanced principles, methods and tools to improve design.
References

[1] L. Blessing, and A. Chakrabarti, “DRM: A design research methodology” In: proceedings of les science de la conception, March 15- 16 2002. INSA de Lyon, Lyon. [Online] 2002 [Accessed 31 January 2019] Available at: www.cpdm.iisc.ac.in/UID_d1.pdf.

[2] K. Friedman, “Creating Design Knowledge: From Research into Practice”, IDATER2000 Conference, Loughborough: Loughborough University. [Online] 1997 [Accessed 31 January 2018] Available at: http://www.academia.edu.

[3] H.A. Simon. “The science of the artificial” (3rd Ed.). Massachusetts Institute of Technology. MIT Press, 1996.

[4] B. Hillie, “Space is the Machine: A Configurational Theory of Architecture”, Electronic edition, Space Syntax, London. [Online] 2007 [Accessed 15 October 2018] Available at: http://discovery.ucl.ac.uk/3881/1/SITMpdf.

[5] R. Padovan, “Proportion science, philosophy, architecture” (3rd Ed.). Routledge, London, 2008

[6] R. Wittkower, “Architectural principles in the age of humanism” (5th Ed.). Academy Editions, GB., 1998.

[7] L.B. Alberti, “On the art of building in ten books” Translated by J. Rykwert, N. Leach, and R. Tavernor. The MIT Press, MA, USA, 1988.

[8] F. Bashier, “A Methodology for Architecture Theory and Practices Research: Design Practices Evaluation Studio. European Journal of Sustainable Development”. Doi: 10-14207/ejcd. Vol. 8, Issue 4, pp. 195- 203, 2019. ISSN: 2239- 5938.

[9] Royal Institute of British Architects, “Architects and research-based knowledge: A literature review”. [Online] 2014 [Accessed 18 January 2019] Available at: http://www.architecture.com.

[10] A. Chakrabarti “Towards Taxonomy of Design Research Areas”, in Birckhof, H. (Ed.). The Future of Design Methodology. DOI: 10.1007/978-0-85729-615-3_22, Springer-Verlag London Limited. [Online] 2011 [Accessed 31 January 2019] Available at: http://link.springer.com.

[11] I. Nonaka, “A dynamic theory of organizational knowledge creation”. Organization Science/ Vol.5, No. 1, February 1994 [Online]. [Accessed 20 December 2020] Available at: josephmahoney.web.illinois.edu.

[12] P.E. Vermaas, “Design Theories, Models and Their Testing: On the Scientific Status of Design Research”, in Chakrabarti, A. and Blessing, L. T. M. (eds.), An Anthology of Theories and Models of Design. p.p. 48- 66, DOI: 10.1007/978-1-4471-6338-1_2, Springer-Verlag London, 2014.

[13] D.A. Kolb, et al. “Experiential learning theory: previous research and new directions, Case Western Reserve University, Cleveland”, OH 44106. [Online] 1999 [Accessed 12 December 2020] Available at: http://www.researchgate.net/publication/284458870

[14] E. Sanders, “Design research at the crossroads of education and practice”. Tongji University and Tongji University Press.[Online] 2017 [Accessed 1st January 2019] Available at: http://reader.elsevier.com.

[15] R. Aburamadan, and C.Trillo, “Applying design science approach to architectural design development. Higher Education Press Limited Company, ScienceDirect. [Online] 2019 [Accessed March 2021] Available at: www.sciencedirect.com.