Second Research Workshop

„Archetype Analysis in Sustainability Research"

28th Feb. – 2nd March 2018, Humboldt Universität zu Berlin

Workshop Report

CONTENT

Please cite this report as follows:

Eisenack, K., A. Gotgelf, U. Kasymov, P. Lutz, P. Perez, C. Oberlack and D. Sietz (2018) *Second Research Workshop on Archetype Analysis in Sustainability Research*, Workshop Report, 28th Feb. – 2nd March 2018, Humboldt Universität zu Berlin, Germany.

1   INTRODUCTION

The 2nd workshop "Archetype Analysis in Sustainability Research" is a follow-up of a first workshop which took place in May 2017 in Bern, Switzerland (Oberlack et al. 2017). The series brings together senior and young scholars who are experienced in or interested in archetype analysis. It is meant to advance the approach and to exchange recent experiences from different disciplinary angles.

Archetype analysis is a powerful approach to reveal recurrent patterns of factors and processes that shape (un)sustainable social-ecological systems. Knowledge on archetypical patterns across cases has supported a better understanding of key sustainability challenges, among others relating to land use, climate change adaptation, vulnerability, large-scale land acquisitions, ecological footprints and regional development (Oberlack et al. 2018). The approach got a prominent place in the UNEP (2007) Global Environmental Outlook 4, and it has been applied to an increasing scope of themes in the past years. A diversity of qualitative, quantitative and mixed methods (e.g. qualitative comparative analysis, cluster analysis, meta-analysis of case studies, scenario development) are suited to analyse archetypical patterns, depending on research purposes and conditions. However, best practices of archetype analysis as well as the significant potentials to effectively combine multiple methods for archetypes analysis are currently a prime frontier of innovation.

The first workshop brought together 29 scientists from land-use science, regional environmental modelling and institutional analysis, and discussed various open issues and avenues for further research. As further outcomes, the workshop decided to have a follow-up workshop in Berlin (this one), and kicked-off a special feature on "Archetype Analysis in Sustainability Research" in Ecology and Society. More than 25 expressions of interest to contribute were submitted in September 2017. Three of them are papers jointly developed in the Bern workshop, that were now presented in Berlin: one focusing on the meaning of archetypes, one on quality criteria for archetype analysis, and one on the methodological portfolio for conducting archetype analysis. Deadline for submission to Ecology and Society is July 15th, 2018.

In addition to presenting and discussing submissions to the special feature, the Berlin workshop also aimed at broadening the community, and further develop a common understanding of and criteria for conducting archetype analysis.

2   PROGRAMME

Wednesday, 28th February 2018
13.00   Arrival and registration, welcome coffee & tea
13.15   Opening session (facilitator: Klaus Eisenack)   ● Welcome, introduction of participants, workshop objectives and programme
14.15   Session 1: Taking stock of the overall process on archetypes and the key insights gained so far (facilitator: Klaus Eisenack)   ● Overall archetypes process: Recalling 1st Archetypes Workshop, stocktaking of activities and key insights (Christoph Oberlack)

	● Perspectives on key insights gained so far
	    ○ David Manuel-Navarrete
	    ○ Diana Sietz
	    ○ Matteo Roggero
	    ○ Rong Tan
	    ○ Tomas Vaclavik
	● Plenary discussion

16.15	Coffee break
16.45	Session 2: "Land-use and biodiversity" applications (facilitator: Tomas Vaclavik) ● Harmackova et al. / Exploring the strengths, weaknesses, opportunities and challenges of using scenario archetypes in science-policy processes: a cross-regional comparison. Discussant: David Manuel-Navarrete ● Gong et al. / Successful collective action in land consolidation in China: An archetype analysis. Discussant: Phillip Grundmann ● Wang / Sustainable rural land redevelopment in China: archetypical determinants. Discussant: Regina Neudert ● Neudert et al. / How do resource scarcity, collective management and socio-economic conditions influence sustainable pasture management in the South Caucasus? Discussant: Ulan Kasymov
18.45	Closing of day 1 and outlook to day 2 (Klaus Eisenack)
19.00	Paper clubs / breakout groups
20.00	Workshop dinner

Thursday, 1st March 2018
8.45	Welcome back, coffee & tea
9.00	Agenda setting for the day (Diana Sietz)
9.15	Session 3: Towards a consolidated common understanding of the archetype approach in sustainability research (facilitator: Sergio Villamayor-Tomás) Part 1: Taking stock of the common core, multiple nuances and main motivations of archetype analysis ● Presentation of draft paper (Christoph Oberlack) ● Discussant (Volker Beckmann), Plenary debate Part 2: Taking stock of the methodological menu ● Presentation of draft paper (Diana Sietz) ● Discussant (Christian Levers), Plenary debate Part 3: Quality criteria for dealing with the methodological challenges ● Presentation of draft paper (Klaus Eisenack) ● Discussant (Zuzana Harmackowa), Plenary debate
11.15	Coffee break
11.45	Session 4: Plenary debate (facilitator: Christoph Oberlack) ● Overarching topics

	● Ideas for future collaboration ● Setting up breakout groups
12.45	Lunch break
14.15	Session 5: Breakout groups or paper clubs ● Groups formed based on author teams or emerging hot topics
15.45	Coffee break
16.15	Session 6: "Climate change & natural resources" applications (facilitator: Rong Tan) ● Kochalski et al. / Coping with environmental change: Archetypes and emergence of adaptive strategies. Discussant: Simona Pedde ● Pedde et al. / Archetyping Shared Socioeconomic Pathways across scales: an application to Central Asia and European case studies. Discussant: Sophia Kochalski ● Gotgelf et al. / Archetypical opportunities for water governance adaptation to climate change. Discussant: Susanne Moser ● Moser et al. / Adaptation finance challenges: Characteristic Patterns Facing California Local Governments and Ways to Overcome Them. Discussant: Leena Karrasch
18.15	Closing of day 2 and outlook to day 3 (Diana Sietz)
18.30	Informal gatherings of breakout groups / paper clubs

Friday, 2nd March 2018	
8.45	Welcome back, coffee & tea, agenda setting for the day (Klaus Eisenack)
9.00	Session 7: "Biodiversity and infrastructure" applications (facilitator: David Manuel-Navarrete) ● Karrasch et al. / Land use elements and attributed ecosystem services enable an archetype approach to climate adaptation in an integrated coastal management. Discussant: Rongyu Wang ● Villamayor-Tomas et al. / An archetypes look at water-energy-food transitions and governance problems. Discussant: Anastasiia Gotgelf ● Sterzel et al. / Global typology of coastal urban vulnerability under rapid urbanization. Discussant: Matteo Roggero
10.30	Coffee Break
11.00	Session 8: Breakout groups prepare report
11.45	Session 9: Closing plenary (facilitator: Klaus Eisenack) ● Reports of breakout groups ● Overarching topics
12:30	Deciding on next steps
13.00	End of workshop

3 KEY INSIGHTS

This section presents overarching results from the stocktaking sessions, general issues that popped up in the discussions of the single papers, and results from the breakout groups. The substantive findings of the papers are not reported here – please contact the respective authors or consult the google drive (see Appendix).

3.1 Towards a consolidated common understanding: taking stock

Various understandings of archetype analysis as an approach where discussed, some arguably being more common than others, while others still require further clarification.

It is common that archetypes are understood as patterns of interaction that bring about global environmental change, or respond to those. Some specifically only consider patterns that stem from interaction between society and nature. Archetypes are constituted by a functional unit of attributes and the relations between them (Eisenack et al. 2006). Archetypes aim at identifying appropriate generalizations for knowing and/or deciding across cases (Oberlack et al. 2018). As each AT functions as a theoretical component to explain phenomena in cases, they are mental representations depicting components of empirical reality.

Studying multiple cases in a comparative way is seen as one cornerstone of the approach, another is the specification of a common vocabulary for each archetype analysis, in order to develop an overarching structure. This common vocabulary, e.g. consisting of variables or attributes, is used to describe heterogeneous cases, possibly from different epistemic or disciplinary stand points (Eisenack et al. 2018). The approach seems to be particularly suitable when complexity is high and cases are heterogeneous, but still share some similarities. Archetypes are something similar to a pattern model, which is specific, and is repeated in different places. They represent replicated temporal, spatial and institutional patterns. Archetype analysis allows simplifying complexity and gaining new knowledge.

One specific promise is seen in being conducive to learning and transfer between cases, e.g. between similar regions. General strategies can be tailored to local conditions. Archetypes can provide stimulus to discuss transfer for uptake of successful strategies or to identify duplicable and applicable institutional settings. The approach might also provide incentives for particular actors to self-portray as pioneers. While an archetype analysis can be action-oriented in this sense, it can also be primarily positive, aimed at explaining phenomena.

Archetype analysis is called an approach to tell it apart from specific methods (like QCA, cluster analysis, inferential statistics or process tracing), as multiple methods can be compatible with conducting an archetype analysis, depending on the research questions and available data (Sietz et al. 2018). Archetype analysis is yet not arbitrary, as it represents a specific way or style on how to address the analysis.

Archetype analysis is seen to fill a middle ground beyond nomothetic and idiosyncratic traps, between local realities and global narratives. It aims to achieve some degree of generalization and formalization with case-level validity. Archetype analyses attempt to establish a parsimonious set of attributes and relations. One challenge for a good archetype analysis is to obtain a coherence between configurations of attributes, theoretical building blocks, empirical evidence, and level of abstraction (Eisenack et al. 2018).

Identified questions

The stocktake also identified some less common issues and areas for improvement. Across the presentations, there were differences in terms of terminology. Although this might be partially due to the flexibility of the approach to be adapted to different research questions, more terms and definitions seem to be necessary to clarify the approach. This refers, for example, to the meaning of and tensions between archetypes, building-blocks and attributes. What makes a type (e.g. identified through classifications algorithms) an archetype? Different studies use different cases or units of analysis. While some see the approach as place-based with the motivation to assess transferability of findings to other geographical areas, others also treat processes, causal mechanisms or other units as cases. It was thus suggested to develop an indicative glossary of key terms.

A spectrum of different positions were discussed whether an archetype analysis requires building-blocks (e.g. there are cases where multiple archetypes hold), or whether also a crisp classification of cases can be seen as an archetype analysis. Another issue is whether an archetype analysis requires an inter-disciplinary integration, or just admits it. Themes that were repeatedly discussed but not concluded, also in the first Bern workshop, are issues on how to validate archetype analysis, and how to establish causality. These discussions show that to
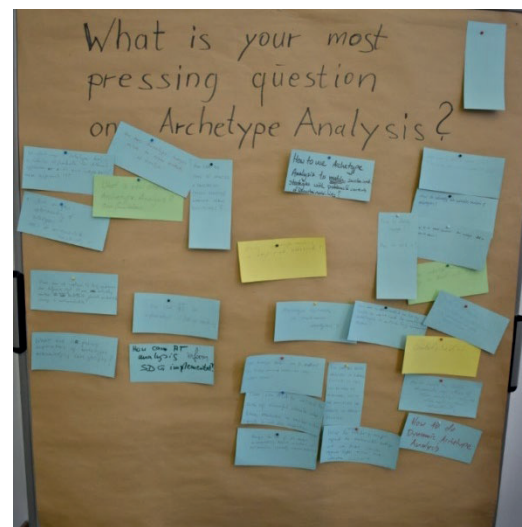
work out the specific features of archetype analysis in relation to other existing approaches is still not completely done.

3.2   Thematic groups

At the beginning and during the workshop participants were offered to pin their questions of interest to the wall or type them into google docs.
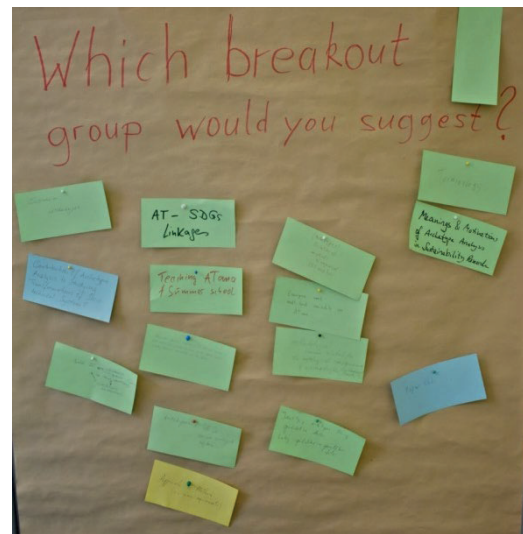
Pressing Questions

- How does archetype analysis relate to other methods of analysis?
- In which ways is archetype analysis a collection of/umbrella for different approaches or is it an independent method?
- What is new about archetype analysis? e.g. microfoundations?
- How can we make AT analysis a mainstream (widely accepted) approach across disciplines?
- Could/is AT being used in empirical research?
- How can AT be implemented in policy making?
- How can AT analysis inform SDG implementation?
- What are the policy implications of archetypes acknowledging case specificity?

- How can we explain to lay audiences the difference that AT analysis actually makes in terms of dealing with global environmentally change and sustainability?
- How to use AT analysis to match sustainable strategies with problems and contexts of unsustainability?
- How to identify an archetype and the suitable numbers of archetypes?
- How can fundamental building-blocks be identified to analyze archetypes in future studies (e.g. scenarios)?
- How to do dynamic AT analysis?
- How can we define AT of farming systems, so they can be used as meaningful units for evaluating the impacts of agriculture policies?
- How can AT analysis be employed for finding promising solutions for water conflict issues?
- How can AT analysis be utilized to scale up successful climate adaptation measures in similar cities? (especially in international development and cooperation)
- How is the role of AT analysis in sustainability research in context of land resources (especially common resources)?

- Contribution of archetype analysis to studying transformations of sociotechnical systems
- Scenario archetypes
- Archetype and sustainable development goals linkages
- Teaching AT analysis in summer school
- Linkage betweem adaptation and mitigation with AT
- Archetypes relation of methods of empirical SES analysis
- Emergence and multi-level causality in AT analysis
- Methodological issues related to the ontological consequences of epistemologies (epistological diversity)
- Terminology
- Meaning and motivations of AT analysis in sustainability research

Five breakout groups worked on specific topics and presented their results in the end. Their insights are integrated in this section above and below:

1. Improving precision on the meaning and particularities of archetype analysis and providing a glossary of key terms.
2. Quality standards and good practice: what makes a good archetype analysis? How to deal with the trade-off between accuracy and meaning?
3. Methodological menu: what are the methodological frontiers?
4. Archetypes at the science-policy interface and the SDGs: How to communicate AT and their use for policy-making? How to make them understand what it means and how to visualize results?
5. Archetypes summer school: How to design it and where to plan it? What would be good core readings?

3.3 Overarching findings and important open issues

Several conceptual clarifications and qualifications were discussed and proposed (see glossary of key terms in the Appendix). These discussions will also be taken up in several submissions to the special feature.

It was emphasized that archetype analyses can be both inductive and deductive, depending on the purpose. The approach can be aimed at theory building or theory testing. Multiple archetype analyses can be built on each other, for example one inductively identifying a larger suite of archetypes, while other studies research particular archetypes in detail, starting from a theory or hypothesis. A full archetype analysis might require multiple studies or papers.

Open issues

There are several controversial or open issues newly or repeatedly identified.

While some participants see the concept of building-blocks (multiple archetypes can hold in a single case) indispensable for archetype analysis, others do not. Proponents of the first group do then ask about what makes archetype analysis distinctive from other approaches like cluster analysis. Other claim that what makes archetype analysis specific might differ between epistemic or disciplinary perspectives. Those that consider building-blocks as indispensable need to provide a specific reason and need to clarify what those building-blocks represent if it is not cases (might they represent e.g. processes, mechanisms, components). What generally requires clarification is how archetypes are exactly linked to cases.

Discussions on validity and causality centred around whether explicit consideration of causality make archetype stand out, how to deal with partial causation, how to stress case-level validity in relation to causal statements supported from regression models. What are valid ways to build theory in archetype analysis, and how can the quality of an analysis can be challenged?

There was no consensus so far whether scenario archetypes cover the basic features of archetype analysis.

Further desiderata are methodological and conceptual ways for conducting an archetype analysis of dynamic systems. A less static view seems to be important to study transformation strategies or the sustainable development goals.

The transferability potential promised by archetype analysis is still contested. While the UNEP (2007) study is one example, a more general proof-of-principle is still required. This holds for both the potential for heuristic value and how to learn between communities or cases in terms of policy making. It is necessary to find those similarities or common contexts that policy-making strategies can be transferred. Since there can be attributes that are so concrete that they can't be transferred, finding the appropriate level of abstraction for transferability is essential. A good archetype analysis requires a matching of strategies and problems.

There seems to be some new common ground in that a good archetype analyses may follow a clear step-by-step or iterative protocol, tailored to the research question and the inductive/deductive objective. Some possible steps in such a protocol were discussed, e.g. define the SES and the vulnerability perspective; build and define mechanism hypotheses; select (spatially explicit) indicators; interpreting and understanding mechanisms; validation; study the interplay of mechanisms; identifying cases; identifying patterns through classification methods; regression; verifying cases.

4   NEXT STEPS

The participants agreed that a third workshop would be very welcome and useful. Tomáš Václavík (Ecology & Environmental Sciences, Palacký University Olomouc) volunteered to host the next workshop. All participants strongly thanked Tomas Václavík for this offer. It was discussed that a date in the first or second quarter 2019 would be good.

Possible topics covered by the third workshop might be:
- Focusing on specific open issues identified
- Systematic learning on how to do an archetype analysis, and the different ways how to do it
- Improving the glossary of key terms
- Policy science interface
- Criteria to make an appropriate case selection for archetype analysis
- Herrenhausen Conference proposal for an «Archetypes Conference»
- Continuity after summer school

The special feature in Ecology and Society will be further processed. Deadline is July 15th, 2018, the review process will take several months, some workshop participants will be asked to be reviewers.

Several participants volunteered to run a Summer School on Archetype Analysis in October 2018 at Humboldt-Universität zu Berlin: Klaus Eisenack, Markus Hanisch, Zuzana Harmáčková, Ulan Kasymov, Christoph Oberlack, Matteo Roggero, Diana Sietz, Tomáš Václavík, Sergio Villamayor-Tomas. The summer school will be open to both young and experienced scholars, and will also teach other useful methods. A call will be distributed in due course.

Several ideas for collaborative research proposal where discussed, and applications for special sessions at various upcoming conferences, including: ECPR, GLP Open Science Conference, Workshop on the Ostrom Workshop 6, Utrecht Conference on Earth System Governance, 17th IASC Global Conference, 5th Nordic Conference on Climate Change Adaptation, and Tropentag.

5   APPENDIX

5.1   Resources

The workshop presentations are available in the Google drive folder:
https://drive.google.com/drive/folders/0B1xFlAxWhJSmWl9QOG1QazdQTTA

There is a mailing list archetypes.thaer@lists.hu-berlin.de. All members of the list can distribute information about Archetype Analysis (Workshops, new papers, events, etc.), and can get into contact (e.g. looking for project partners, conference sessions, general question, etc.). All members can post. The list contains all people that registered for the first or the second workshop, and some other individuals (nearly 60 members, administered at Humboldt University, please contact Ines Jeworski <i.jeworski@agrar.hu-berlin.de>).

5.2 Participants

Name	Affiliation	e-Mail
Anastasiia Gotgelf	Humboldt Universität	gotgelan@hu-berlin.de
Anke Wolff	Humboldt Universität	anke.wolff@hu-berlin.de
Ariane de Bremond	Universität Bern	ariane.debremond@cde.unibe.ch
Christian Levers	Humboldt Universität	christian.levers@geo.hu-berlin.de
Christoph Oberlack	Universität Bern	christoph.oberlack@cde.unibe.ch
David Manuel-Navarrete	Arizona State Arizona	davidmn@asu.edu
Diana Sietz	Potsdam Institute for Climate Impact Research	sietz@pik-potsdam.de
Kate Farrell	Humboldt Universität	katharine.farrell@agrar.hu-berlin.de
Klaus Eisenack	Humboldt Universität	klaus.eisenack@hu-berlin.de
Leena Karrasch	Universität Oldenburg	leena.karrasch@uni-oldenburg.de
Matteo Roggero	Humboldt Universität	Matteo.roggero@hu-berlin.de
Mohammad Naser Reyhani	Leibniz-Institut für Agrartechnik und Bioökonomie	nreyhani@atb-potsdam.de
Naiba Allahverdiyeva	Ernst-Moritz-Arndt-Universität Greifswald	naibaallahverdiyeva@gmail.com
Patricia Perez	Humboldt Universität	patriciapl2192@gmail.com
Patrick Lutz	Humboldt Universität	lutzpatx@hu-berlin.de
Patrick Meyfroidt	Université catholique de Louvain	patrick.meyfroidt@uclouvain.be
Philipp Grundmann	Leibniz-Institut für Agrartechnik und Bioökonomie	pgrundmann@atb-potsdam.de
Regina Neudert	Ernst-Moritz-Arndt-Universität Greifswald	regina.neudert@uni-greifswald.de
Robert Arlinghaus	Leibniz-Institut für Gewässerökologie und Binnenfischerei	arlinghaus@igb-berlin.de
Rong Tan	Zhejiang University	tanrong@zju.edu.cn
Rongyu Wang	Zhejiang University	wangrongyu@zju.edu.cn
Sergio Villamayor Tomas	Autonomous University of Barcelona	villamayortomas@gmail.com
Simona Pedde	Wageningen University & Research	simona.pedde@wur.nl
Sophia Kochalski	Leibniz-Institut für Gewässerökologie und Binnenfischerei	kochalski@igb-berlin.de
Susanne Moser		promundi@susannemoser.com
Till Sterzel	Climate-Babel	till@climate-babel.org

Tomas Vaclavik	Helmholtz-Zentrum für Umweltforschung UFZ	tomas.vaclavik@ufz.de
Ulan Kasymov	Humboldt Universität	kasymovu@agrar.hu-berlin.de
Volker Beckmann	Ernst-Moritz-Arndt-Universität Greifswald	volker.beckmann@uni-greifswald.de
Yanqing Gong		444631907@qq.com
Zuzana Harmáčková	Stockholms Universitet	zuzana.harmackova@su.se; harmackova.z@czechglobe.cz

5.3   List of papers

Authors	Name
Rongyu Wang	Sustainable rural land redevelopment in China: archetypical determinants
Sergio Villamayor-Tomas, Diana Sietz, Erle Ellis, Vikrom Mathur, Christian Kimmich, Stephan Rist	An archetypes look at water-energy- food transitions and governance problems
Till Sterzel , Matthias K.B. Lüdeke, Carsten Walther, Marcel T. Kok, Diana Sietz, Paul L. Lucas	Global typology of coastal urban vulnerability under rapid urbanization
Sitas, N* & Harmáčková, Z*, Biggs, O., Kizito, F., Hamann, M., Blanchard, R., Coetzee, K., Harrison, P., Hauck, J., Kok, K., García-Marquez, J., Klatt, B., Ometto, J., Valle, M., Anticamara, J. Ghosh, S., Riordan, P., Gundimeda, H., Niamir, A., Subramanian, S.M., Badola, R, den Belde, E., Lazarova, T., O'Farrell, P., Selomane, O., Santos-Martin, F., Brotons, L., Guisan, A., Cantele, M., Hashimoto, S., Dasgupta, R., Okayasu, S., Shin, Y., Palomo, I.**	Exploring the strengths, weaknesses, opportunities and challenges of using scenario archetypes in science-policy processes: a cross-regional comparison
Diana Sietz, Tomáš Václavík, Ulrich Frey, Matteo Roggero, Yanqing Gong, Nick Magliocca, Rong Tan, Peter Janssen	Archetype analysis in sustainability research: Methodological potentials, challenges and the way forward
Simona Pedde, Kasper Kok, Katharina Hölscher, Rik Leemans	Archetyping Shared Socioeconomic Pathways across scales: an application to Central Asia and European case studies
Christoph Oberlack, Diana Sietz, Ariane de Bremond, Elisabeth Bürgi-Bonanomi,	Archetype Analysis in Sustainability Research: Common Core, Multiple Nuances

Jampel Dell'Angelo, Klaus Eisenack, Erle Ellis, Graham Epstein, Markus Giger, Andreas Heinimann, Christian Kimmich, Marcel Kok, David Manuel-Navarrete, Patrick Meyfroidt, Pete Messerli, Tomáš Václavík, Sergio Villamayor-Tomás.	and Motivations
Regina Neudert, Anja Salzer, Naiba Allahverdiyeva, Jonathan Etzold, Volker Beckmann, NN	How do resource scarcity, collective management and socio-economic conditions influence sustainable pasture management in the South Caucasus? - Evidence from case studies on common village pastures in Georgia and Azerbaijan
Kochalski, S., Harrison, H. & Arlinghaus, R.	Coping with environmental change: Archetypes and emergence of adaptive strategies
Leena Karrasch, Thomas Klenke, Michael Kleyer	Land use elements and attributed ecosystem services enable an archetype approach to climate adaptation in an integrated coastal management
Anastasiia Gotgelf, Matteo Roggero, Klaus Eisenack	Archetypical opportunities for water governance adaptation to climate change
Yanqing Gong, Rong Tan	Successful collective action in land consolidation in China: An archetype analysis
Klaus Eisenack, Sergio Villamayor-Tomas, Graham Epstein, Christian Kimmich, Nick Magliocca, David Manuel-Navarrete, Christoph Oberlack, Matteo Roggero, Diana Sietz, NN	Quality standards to deal with challenges to archetype analysis

*Joint first authors
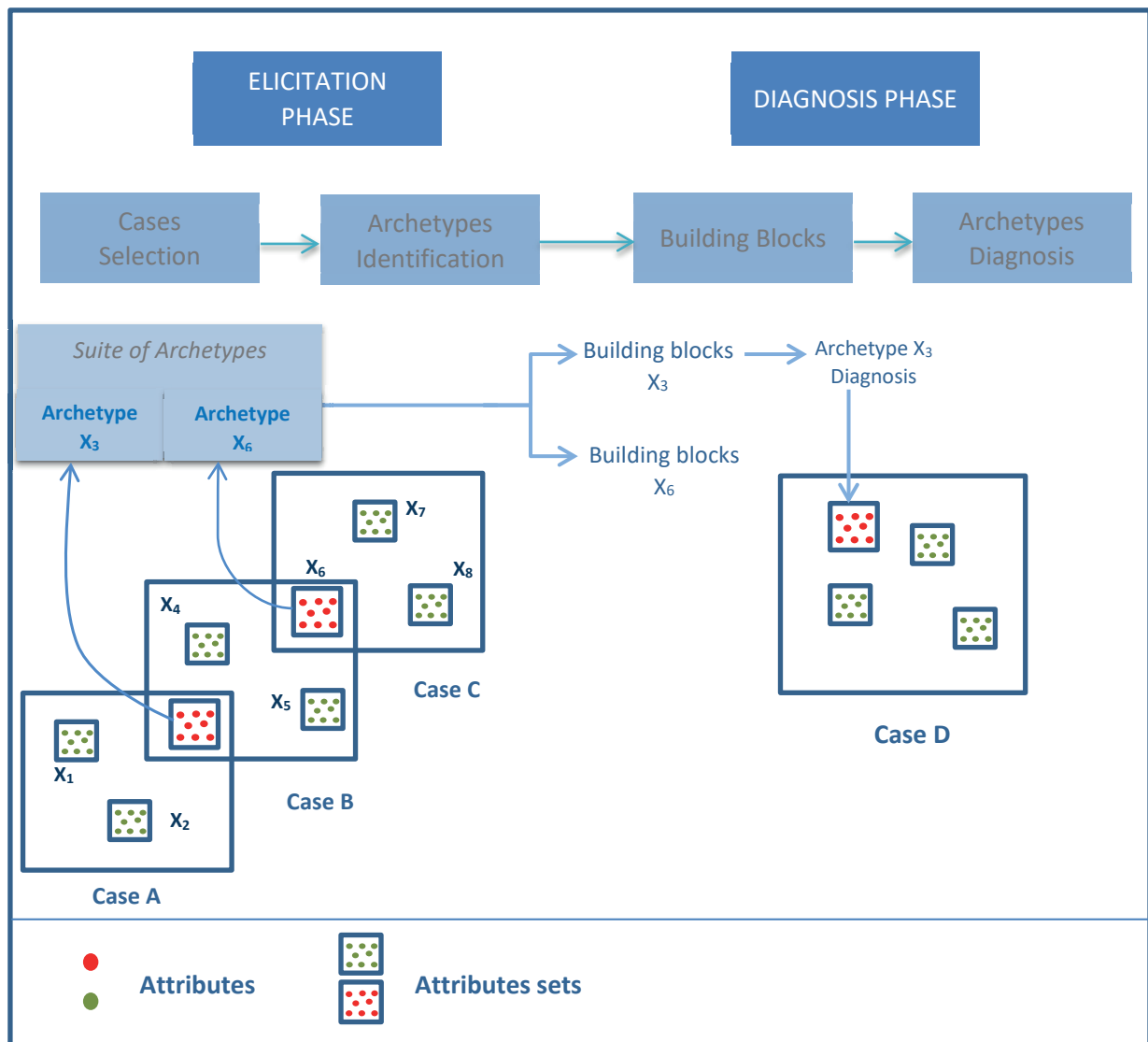****authorship to be determined based on further input**

5.4   Glossary of key terms

Klaus Eisenack, David Manuel-Navarrete, Christoph Oberlack, Diana Sietz, Christian Kimmich

This glossary seeks to provide a consistent terminology to facilitate Archetype Analysis (ATana).

Archetype Analysis. Archetype Analysis (ATana) is any orderly scientific procedure that produces a suite of ATs to analyze patterns that hold in a set of cases, phenomena or observations, usually heterogeneous in character. ATana typical involves two phases. First,

the elicitation phase consisting of identifying a set of cases relevant for the phenomenon under investigation, characterizing the attributes (and relationships) present in every case, abstracting combinations of attributes (and relationships) that are archetypical for that particular set of cases, and providing a theoretical rationale or explanation for the combination of attributes. Second, the abstracted combinations of attributes (and relationships), which are the archetypes proper, are used in the diagnostic phase as building blocks to diagnose the presence of identified archetypes in additional cases (Figure 1).

There is not "one" archetype analysis, but each research project may produce its particular archetype analysis which may be different from other archetype analyses. Yet, it is also possible that one archetype analysis refines, improves, replicates or (in)validates another archetype analysis. It is also possible that one archetype analysis borrows some components from another, and adds new components.

Archetype analysis is an approach (in contrast to a framework, theory or method), because it can accommodate and combine different frameworks, theories and methods. Archetype analysis is, in principle, compatible with any method that identifies or tests patterns or configurations of attributes, such as cluster analysis or qualitative comparative analysis.

13

Suite of Archetypes. An ATana produces more than one archetype. The set of all archetypes in an ATana is called a suite. Each single archetype in a suite can be diagnosed in multiple cases, but not all archetypes of the suite are diagnosed in a single case. A suite of archetypes can be extended when new archetypes are observed, and are therefore not necessarily exhaustive. Suite completeness depends on whether archetypes can be logically (combinatorically) or empirically exhaustive.

Attributes & Outcomes. Cases and archetypes are described by using a set of attributes. Synonyms for attributes can be factors, characteristics, features, quantitative variables, ordinal variables, nominal variables or factors. Every case or observation is composed of a set of attributes. Archetypes are abstracted combinations or subsets of attributes that hold in more than one case. For each case or archetype, it can be principally described whether an attribute is present there, or to which degree or level or in which sense it is present.

A main practical use of ATana is to understand why the outcomes of a given phenomenon differ across cases and how this cross-case understanding can inform interventions to alter undesirable outcomes. Unlike the SES framework or the Tragedy of the commons, ATana is a general approach to characterize all kind of outcomes resulting from social-ecological relationships. There can be single or multiple outcomes considered. Outcomes might be normatively justified, or stem from positive questions. Outcomes can be part of archetypes, or external to archetypes. Outcomes can be understood as explained variables (like in QCA or inferential statistics), they can be understood as evaluations, or they can be understood as components of functional relations (where outcomes and other attributes might be explananda for further outcomes and attributes).

Cases vs. Systems. Archetype analysis investigates a set of units of analysis, called cases (or, more generally, observations). Cases can be places, gridcells, organizations, models, institutions, actions, processes, mechanisms or systems. Each case can consist of multiple components. Systems are a set of connected components forming a complex (usually functional) whole. In contrast, AT are abstractions whose function is purely analytical: to explain typical patterns repeated across a range of cases. AT are conceptual constructs to explain why a similar outcome happens across different cases (thus under apparently different circumstances or characterized by diverse social and ecological attributes relations).

The cases are taken from a "universe of cases" that needs to be specified: what kind of cases are "eligible" to be subject of the ATana. The data taken for the ATana is then usually a subset of the universe of cases.

Heterogeneous cases. ATana is designed to study sets of cases that are quite different in their attributes, possibly also with data gaps. Heterogeneity means more than much variation in variables. A heterogeneous set of cases likely has more relevant attributes than more homogenous cases.

Configuration of attributes. An archetype is not described by a single attribute, but a combination of multiple attributes and their relations. This can be understood as a list of attributes or a range of values of variables. It can also be understood as a specific and more complex relation of attributes or values, e.g. through a mathematical function, Boolean formula or narrative. Relations between attributes are often, but not necessarily, defined by some form and degree of causality.

Theories. ATs are abstractions whose function is to explain typical patterns repeated across a range of cases (versus explaining cases or classifying them). This process of abstraction can be based on theory, or the theory of each archetype can be derived inductively. It requires that the analyst is explicit about what middle-range theory guides what/how attributes are selected what causal mechanisms are emphasized to explain why a certain outcome occurs across cases, or to classify the sets of attributes and mechanisms leading to the same outcome, or to provide a rationale for configurations of attributes.

These theoretically informed configurations or mechanisms are building blocks and can be combined with (some) other building blocks to explain either a whole case, set of cases, or larger (embedded) outcomes (one could think of a hierarchy of outcomes within an observation).

Good archetypes make a fit between theory and empirical observations. Every ATana starts with a set of ideas and principles about the alternative mechanisms that can (are needed to) explain a certain outcome. This set of ideas and principles is a "small" theory linked about an outcome or configuration of attributes. For instance, the outcome of common pool resources dynamics were explored by Ostrom et al. through a "theory" proposing that rules are the basic mechanism to explain outcome in these systems. Their IAD framework proposed a set of attributes and relations to explore the sustainability of outcomes from rule-following in common pool resource cases. Archetypes and building blocks can be created by identifying recurrent patterns of attributes and relations in a set of common pool resource cases. We would say that these archetypes were informed by IAD "theory".

A single ATana might draw theory from multiple epistemic communities. Then, while some archetypes in the suite might only use "small theory" from one "grand theory", others might be able to combine bits from multiple "grand theories". It might also be the case that some ATs from the same suite cannot be combined because they draw from contradicting or incommensurable "grand theories".

Common vocabulary of attributes. While cases and archetypes are described by attributes, it is not required that every case or archetype is characterized by the same set of attributes. This is different to, for example, standard inferential statistics or QCA, where all data points in a sample need to have complete data in all attributes from the model. So, while some cases/archetypes draw on specific attributes, others will do so on others. This can mean two things: (i) there are data gaps, (ii) more importantly: some attributes are irrelevant for cases/archetypes.

In the extreme situation, however, if every archetype/case is described by a very particular set of attributes that does not overlap with the attributes of any other archetype in the suite, we do not obtain an archetype analysis. Instead, there need to be at least an overlapping list of attributes and a common vocabulary across cases that is used for one complete ATana. In each ATana, all archetypes/cases use only attributes from this list (the 'common vocabulary') which is defined for this ATana. Each attribute in the vocabulary shall be used multiple times (although not always).

Building-block. Importantly, ATs are building blocks: they do not explain whole observations (this would be the goal of systems' representations), and therefore AT do not aim at completely representing a system or case. In other words, archetypes describe or explain components

that occur within a case, but not complete cases. Because archetypes can be used as building blocks, it is required that a suite of them can coherently be combined to analyse a particular case. Drawing from a common vocabulary of attributes is one pre-condition for that. It also requires that the theoretical/epistemic background is not utterly incompatible between any pair of archetypes.

Archetypes versus building blocks. Archetypes are elicited from a suite of cases and are used as building blocks to diagnose new cases. Diagnosing that a building block holds in a new case means that it can be (positively) validated that the theory and configuration of attributes characterizing this archetype are present in a specific case. How this is established depends on the (empirical) methods chosen in the ATana.

Validity. What components of an archetype analysis can be subject to validity, i.e. can be falsified?

- Internal validity: Statements that one AT holds in a specific case can be validated according to the standards of the empirical methods used in an ATana.
- External validity: Implications of an ATana, e.g. for outcome attributes external to the ATana, can be validated with other methods/approaches/data that relate to the implications.
- Quality criteria, e.g. whether an ATana follows specified recommendations, protocols, or general criteria of good scientific practice.

Domain of validity. The domain of validity is the set of cases in which an archetype holds. The larger the domain of validity, the higher generalizability and transferability of the archetype.

Archetype. Each AT functions as a building-block that can be used to explain phenomena in particular cases. Thus, each AT is characterized by (i) a configuration of attributes, (ii) a theory that explains the relation between the attributes, and (iii) the set of cases where it holds (called the domain of validity).

Archetype vs. Patterns. Archetypes are patterns of social and ecological attributes, and their relationships. In this view, AT is a particular kind of patterns. The term 'pattern' is vaguer and it does not refer to any specific research approach. ATana, on the contrary, is a research approach.

Components. Cases or observations can be considered to contain multiple components. These components can be processes, models, mechanisms or causal relations. Each component can be characterized by a set of relations that link attributes.

An ATana does not classify cases, but components, i.e. parts of cases. Thus, multiple archetypes can manifest in one case if there are multiple components, each associated with another archetype.

An Archetype holds in a case. When it can be justified that a particular archetype is associated with a case or observation, it can be said the this archetype holds in the case. This is usually the case if some component(s) of the case fit to the characterization of this archetype. Alternative formulations are that the archetype manifests, is observed in, or diagnoses the case. All cases where a specific archetype holds are it's domain of validity.

Level of abstraction. The result of an ATana depends on the chosen level of abstraction of the attributes and cases. Level of abstration of cases can mean different things: spatial

resolution (plot/place/gridcell/region/continent etc.), functional boundaries (e.g. employee/unit/firm/sector), institutional level (e.g. municipality/county/province/country etc.), temporal resolution (day/month/year/decade), and others.

Also the level of abstraction of attributes can mean different things among spatial and temporal resolution, aggregation (e.g. daily average/yearly average; firm-level /national-level/sector-level data), or conceptual abstraction (e.g. actors: human individual/employee/profession/lawyer/specialization/experience; or institutions: governmental policy/market based/emissions trading/emissions trading with grandfathering).

Scaling, super- and sub-archetypes. A basic characteristic of building blocks is that they are scalable through combination with other building blocks described at higher levels of abstraction.

5.5   References

Eisenack, K., M. Lüdeke, and J. Kropp. 2006. Construction of archetypes as a formal method to analyze social-ecological systems. In: Proceedings of the Institutional Dimensions of Global Environmental Change Synthesis Conference, Bali.

Eisenack, K., S. Villamayor-Tomás, G. Epstein, C. Kimmich, N. Magliocca, D. Manuel-Navarrete, C. Oberlack, M. Roggero, and D. Sietz. (2018) Design and quality criteria for archetype analysis. Submitted to Ecology and Society.

Oberlack, C., A. Winiger, P. Kupferschmied, D. Sietz and K. Eisenack. 2017. Research Workshop Archetype Analysis in Sustainability Research, Workshop Report. University of Bern, Switzerland, 2-4 May 2017.

Oberlack, C., D. Sietz, A. de Bremond, E. Bürgi-Bonanomi, J. Dell'Angelo, K. Eisenack, E. Ellis, G. Epstein, M. Giger, A. Heinimann, C. Kimmich, M. T. J. Kok, D. Manuel-Navarrete, P. Meyfroidt, P. Messerli, T. Václavík, and S. Villamayor-Tomás (2018) Archetype Analysis in Sustainability Research: Meanings, Motivations, and Evidence-Based Policy-Making, submitted to Ecology and Society.

Sietz, D., U. Frey, M. Roggero, Y. Gong, N. Magliocca, R. Tan, P. Janssen, T. Vaclavik (2018) Archetype analysis in sustainability research: methodological challenges, potentials and analytical frontiers, submitted to Ecology and Society.

UNEP. 2007. Global Environmental Outlook 4. Nairobi: United Nations Environment Programme.