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# **Design Process as Argumentation:** Horst Rittel and the Systems Theory Approach in Architectural Education

*When we think of the milestones in the history of architectural education, usually institutions such as the Ecole des Beaux-Arts, the Bauhaus, and the arrival of Walter Gropius at Harvard's GSD first come to mind. But do we ever think of less heroic moments, such as when scientific methods slowly trickled into architectural pedagogy to create what we refer to today as the built environment?*

*Starting in the post-war era and gaining traction during the early 1960s, tertiary institutions in the US, UK and Australia took on an interdisciplinary approach to architecture and urban planning, and in turn filled their faculties with experts from outside of the discipline; a cohort which included social scientists, geographers, and psychologists. Initially MIT, and later, UC Berkeley's College of Environmental Design and UCL Bartlett's Studies in Environmental Design integrated scientific methods applied and proven during wartime with the teaching of design methodologies. The practices of operation research and systems theory became a large part of architectural and urban planning education at this time, when much of the knowledge gained through military and industry was transferred from the theatre of battlefield or factory to the university lecture theatre.*

*This paper endeavours to look at the work of one academic who can be categorised as a major contributor to this scientifically-informed systems approach to design – Horst Rittel. The essay examines Rittel's contribution to systems thinking in design by investigating his teaching curriculum at Hfg Ulm and comparing these subjects with his teaching at the UC Berkeley. Rather than understanding his work as purely rational 'technical escapism', this paper demonstrates some aspects of Rittel's teaching and research which led him to comprise his theory of design as a 'wicked problem' and the value of argumentation as a design process.*

Operation research and systems theory became a large part of architectural education after the Second World War, when much of the knowledge gained through the military was transferred from the theatre of battlefield to the university lecture theatre. Seeing the efficiency and accuracy in planning, industries would soon adopt these methods of scientific analysis. Academic institutions such as MIT, Harvard, and Berkeley filled their faculties with many of the social scientists, and many of these departments included schools of architecture, urbanism and planning.

One such educator who successfully imported a systems approach from industry to architectural education was the mathematician and physicist Horst Rittel. He was not trained as an architect, however his career entailed teaching hundreds of architects, preparing them for a practice which demanded a decision making process based on quantitative, scientific results. Recruited from Germany's Ulm School of Design, Rittel would become the Professor of the Science of Design at the newly emerging field of Design Theories and Methods (DTM) at the College of Environmental Design in Berkeley in 1963. As a pioneer in introducing systems theory to architects, designers, and planners, and as one of the founders of the Design Method Group, a re-examination of Rittel's work is warranted in light of the recent emergence of parametric methods and the prevalent use of Big Data in design. All of these contemporary design processes were transferred from industry and introduced by Rittel at these two academic institutions. This paper will delve into Rittel's academic career and examine the array of courses he offered as part of the curriculum at the Ulm School of Design and at the College of Environmental Design at Berkeley during the 1950s and 1960s. By examining Rittel's teachings, it will endeavour to bring to light this crucial, interstitial moment when designers began preparing for a future practice based on communicating and working with computers, and the promise of cybernetics was first put forth before the prerequisite hardware and software of advanced computing power was developed.

Rittel did not study architecture or design; he majored in mathematics at the University of Göttingen from 1950 to 1954. During this time, he became involved with a young group of researchers from the Institut für Sozialferschung at the University of Münster, who were interested in introducing empirical methods into the social sciences. Rittel provided them basic training in statistics and created survey subjects for the program. As a result of this work, he was offered a PhD candidature at Münster University to develop a "Theory of Prediction." While conducting his thesis, Rittel was employed as a technical consultant for the large German machine tool manufacturer Hoesch A.G. There he took on the realm of operations research, dealing with issues of precision and stability in machine tools, as well as inventory control. It was during this experience where Rittel came to recognise the significant impact of information flow on the company's decision-making process.[1]

This experience with industry placed Rittel in the unique position of being able to transfer technical knowledge developed from the sciences to the design field.[2] This was recognised by Tomas Maldonado, Head of the College of Design in Ulm. In 1958, Rittel was invited to be a tenured lecturer for Design Methodology and Operations Research at the College of

Design. Rather than completing his thesis at Münster University, he accepted the offer at Ulm, and began teaching subjects on operations research and cybernetic thinking such as “Theory of Scientific Inquiry” and “Methodology of Design.”

It is first important to note the significance of Rittel introducing scientific methods of inquiry and decision making to the field of design, and the ideological fount of this type of thinking. Operation Research and systems theory can be traced to the Second World War, when the military sought to implement planning and decision-making tools for logistical problems. These new methods came about from the ideas developed by Austrian biologist Ludwig von Bertalanffy during the early 1920s regarding “open systems.” This idea was further explored by Norbert Wiener through his concept of cybernetics and the theory of feedback loops.[3] Similar to biological systems, open systems were dependent upon the constant flow of information from its surrounding environment. Cybernetics was the study of this movement and flow of information between an object, system, or organism and how the behaviour of these entities was affected by changes, or ebb and flow of information, in the environment. Within this understanding of the environment and the back and forth flow of information, the field of design, then, is understood as a complex data-flow system which can be adapted and modified according to the collecting of data, and the application of mathematical rules and parameters to that data.

In addition to Bertalanffy, Wiener, and Claude Shannon, the statistician Herbert A. Simon, in his book *Administrative Behavior* (1947), demonstrated behavioural and cognitive processes for rational decision-making. This work was followed by a series of lectures at MIT in the spring of 1968, subsequently published as the book, *The Sciences of the Artificial* (1969). This text established the possibility of a science of design, where the ability to transfer scientific methods of processing data was a process that could occur across disciplines. This is based upon the concepts of design as a process whose goal is to improve the existing state of environments. And just as our world is made up of natural objects and natural sciences, it also consists of artificial, human-designed objects contingent upon, and formed by, its environment. This second phenomena constitutes Simon’s concept of a science of the artificial.

Based upon theories such as Simon’s, which called for a scientific, mathematical, quantitative analysis of the built environment, Tomas Maldonado, director of the College of Design at Ulm, created his curriculum. By 1959, Max Bill had stepped down and Maldonado revisited the curriculum according to positivistic-mathematical trends, explaining to the students: “Nowadays ... design problems must be approached and solved on the basis of precise factual knowledge.”[4] The fuzzy subjectivity of the individual genius/artist was replaced by the designer as the precise, informed scientist; one who employed rationalistic methods to develop a type of Taylorist “one best way” for the design process within an industrial context.[5] The new curriculum was defined by subjects taught by Rittel, Max Bense, and Abraham A. Moles on semiotics, organisational theory, and mathematical operation analysis. Rittel’s concentration, mathematical operations, was described by Maldonado as a “discipline developed in the USA, [which] consists of a spectrum of various subjects aimed at mathematically classifying, interpreting, and evaluating operations of any kind. This discipline comprises the following subjects: group theory, set theory, probability, statistics, game theory, linear programming, theory of valuating series, norming, and information theory."[6] Through the teaching of these topics, it was hoped that students would gain practical insight into rigorous, rational planning methods; a process that Rittel would later define as "action planning."[7]

In the essay, "About the Work Hypotheses at the College of Design in Ulm," Rittel described the principles that structured the new design curriculum in a response to a critical article published in 1960 issue of *Werk*, where Lucius Burckhardt criticised the College of Design at Ulm. He claimed that the Ulm school was often reproached about the fact that it was too self-absorbed of an institution to properly care about how it was being represented outside in the world. But Rittel replied that it needed some time to create its own basis of practice and outcomes. Unlike other schools with established traditions, the College of Design had to start from nothing, since it did not inherit a specific ideology, but instead attempted to build a new one based on interdisciplinary approaches.

Unlike established programs which have a coherent approach, the Ulm school consisted of a divergent group, where "each lecturer has one aspect, one meaning, and his own direction."[8] A singular, unified pedagogy in which the entire school followed was antithetical to Rittel. This positioning of different viewpoints was necessary to true design learning, according to Rittel, since "each mutual opinion carries the loss of a debate, which would also leave the loss of correcting the opinions."[9] While this insight might seem quite a banal assessment of how students may benefit from multiple viewpoints and approaches, the idea of the design process as a rationalised method of rigorous debate is a theme which would have a lasting legacy in Rittel's work, later developing this concept during his teaching career at Berkeley.

The task of the curriculum at the Ulm College of Design was organised to accomplish one main directive: toward the training and development of designers. This was accomplished through four important points which correspond to the four departments: Production Design, Industrial Construction, Visual Communication and Information.[10] According to Rittel, there were six principles upon which all four departments were organised, principles based on discussion, iteration, and argumentation – all characteristics that foreshadow his unique understanding of the nature of design processes:

1. Student problems and assignments are based on complex challenges which do not allow for intuition for their resolution. Instead students are directed toward rational methods with quantitative, precise measurements.[11]

2. All problems are interdisciplinary by nature.

3. The problems require what Rittel termed as "a field of tension and diverging interests," which recognises the varying viewpoints of consumers, producers, engineers, distributors, constructors, which is part of any project.

4. Recognition of the tension between theory and practice. “On one hand he is forced to get ahead analytically and deductively, to rationally base his results and to secure on the other hand he [sic] is forced to come to an idea and to realize it.”[12]

5. The designer requires imagination in order to project future realities and must “develop a picture of the ‘world of tomorrow.’”[13] In practical terms, Rittel noted that in order to build a house, the designer must have an idea as to how its occupants will inhabit it. By its nature design embodies “cultural politics” because all artificial, human-made objects are part of culture.

6. Combining aspects of functionality with other concerns such as adaptability to surroundings along with aesthetic problems.

At the end of the essay, Rittel concluded, “the designer is a cultural politician who helps in the designing of the ‘face’ of the ‘world of tomorrow.’” This can only be accomplished if future designers are provided with the proper amount of theory and practice. The curriculum of the College of Design at Ulm was formulated to basically answer the question, “What is really education?” The response was that education provides specific “Knowledges, dexterities and methods, and the knowledge of open and disputable problems.”[14]

Rittel’s teaching workload could be understood as the foundation to Maldonado’s science-based curriculum; an ironic fact considering that Rittel was not a designer. His wide range of subjects included classes on methodology and mathematical operations analysis for all the disciplines. In 1957-58, Rittel taught subjects in the Building Department, which included operations research, group theory, set theory, statistics, linear programming, and for Information Department students, information theory. Later in 1960-66, other subjects included physics, technical physics, general mechanics for Industrial Design students, information theory for Visual Communication students, and for students in the Building Department, new subjects included methodology, structural theory, introduction to mathematical logic, permutations and combinations, topology, theory of science and cybernetics.[15]

Rittel was the perfect candidate to teach these subjects, as his experience in industry allowed him to present the material from a practice point of view rather than a purely theoretical one, and he was described as being able to clearly communicate the knowledge of methodical tools for rationally solving problems. These skills included data collection, use analysis, optimisation, imaginative conception, evaluation procedures, and decision-making, among others.[16] As Wolf Reuter notes, Rittel was able to accomplish Maldonado’s objective for the school, which is to make “design the object of scientific inquiry.”[17] This was accomplished through the understanding that at the basis of science is research, and like the scientist, the designer required the methods and techniques in which to gather and analyse quantitative data. The designer, like the scientist, needed to know how to form a proper, relevant and researchable problem, and like the scientist, the designer needed to know how to evaluate the results and apply those results to the design process.[18] However Ulm would become synonymous with academics on the governing board constantly arguing over the design of the curriculum. By the early 1960s, the amount of visiting instructors numbered 200, whereas the permanent Faculty members numbered 20. This ratio, and the new nature of the design school pedagogy, led to "a constant state of mental unrest" which eventually lead the school to be involved in "conflicts and contradictions."[19] The combative nature of the academic administrative of the Ulm School, and the arguments over how to best prepare designers to resolve contemporary problems, would remain with Rittel, and influence his approach to teaching at his new position at UC Berkeley.

## Teaching at Berkeley

In 1963, Rittel was recruited by UC Berkeley (perhaps the result of a visit to the College of Design at Ulm by Berkeley's Joseph Esherick in the previous year) and was appointed lecturer in the Service of Design. In 1967 he was promoted to Associate Professor, and then Professor and remained at Berkeley for the rest of his career until his death in 1990. Unlike his time at Ulm, there was a synergetic relationship between his teaching and outside research activities at UC Berkeley. In addition to his work within the College of Environmental Design, Rittel also was an Associate Research Mathematician of the Space Science Laboratory and the Center for Planning and Development Research at UC Berkley. He worked with academics and practitioners on projects outside of the University such as a pilot research project sponsored by the US National Bureau of Standards for the development of models and techniques for the evaluating building standards, and how these could effect planning and design decisions.[20] Other teaching and research associations included the co-founding of the Studiengruppe für Systemforschung in Heidelberg, Germany and he served this Institute as consultant and methodological supervisor.

In addition to his coursework at Berkeley, which was at first, similar to his subjects at Ulm and included the psychology of perception, information theory, and operations research, Rittel is also credited as being instrumental in establishing the Design Method Movement in 1963 along with J. Christopher Jones from the Manchester College of Science and Technology and L. Bruce Archer from the Royal College of Art, UK. This movement was adopted into the Berkeley curriculum in 1966 as the research program Design Theories and Methods and was funded by the National Science Foundation, serving as a model for other design methods programs around the world.[21] Along with Rittel, other instructors of design methods at Berkley included operations research specialist C. West Churchman (Professor of Business Administration and Professor of Peace and Conflict Studies), Melvin Webber (City and Regional Planning), and Esherick. A prodigious undergraduate at Berkeley and a student of Rittel, Gary T. Moore, was instrumental in the movement and established the Design Methods Newsletter in 1967. Moore would go on to the University of Sydney, importing these rational methods, and establish the Design Methods Group and a similar iteration called Environment-Behaviour Studies. The reason for the emergence of Design Methods at this time at Berkeley was, according to Rittel, to investigate "ways in which the large-scale NASA and military-type technological problems had been approached might profitably be transferred into civilian or other design areas."[22]

Rittel's teaching experience included thousands of students in multiple subjects through his tenure at Ulm and at Berkeley, however there are three specific teaching moments which begin to signal a sea change in Rittel's approach to rational design methods, a shift which would ultimately lead to two of Rittel's most significant publications and research outputs. The first major teaching experience of Rittel's at Berkeley was his signature subject, Architecture 130: Design Methods. The second was an interdisciplinary seminar run along with C. West Churchman called the Universe of Design. The third item was not a subject in its own right, but was taught as part of Architecture 130 and other elective subjects by Rittel. The IBIS, or Issue-Based Information System, is a model of a transparent design rationale system that collects, structures, and represents reasoning and decisions that occur during planning processes with a group of participants and it can be interpreted as a summation and reflection on his academic career teaching rational methods of analysis.

## Architecture 130: Design Methods

This undergraduate subject taught methodologies of architectural design to a large cohort of students who would later split into tutorial discussion. The subject content was not specific for architectural design, and in theory could be used by planners, industrial designers, and urban designers. The focus, on methodology, derived from the Greek word for 'way through,' and it discussed problems that occurred in all kinds of design fields.[23] The lectures were organised around specific problems which focused on personal and political interaction and conflict during the design process. This included focus on topics such as: What is Design?, The Nature of Design Problems, Models of Designing, Evaluation Systems, Generation of Variety, or Morphologies, Decision Making in Environmental Design, Predicting the Context for Which One Designs, and Models and Systems. These weekly themes were divided into more specific topics, for example the theme Generation of Variety, or Morphologies, was followed by the shorter topics of Creativity, the principle of systematic doubt, morphological boxes (or Zwicky boxes), morphological trees, and the generation of cell configurations and planer graphs for floor plan generation and evaluation.[24]

The students were not assigned a textbook but provided with an extensive list of readings, usually without page numbers, divided into specific topics. For example, under the topic of design process, Rittel listed fundamental texts from other participants of the Design Methods movement such as Morris Asimow's *Introduction to Design*, L. Bruce Archer's *Systematic Methods for Designers*, Martin K. Starr's *Product Design and Decision Theory*, and Churchman's *The Systems Approach*. Under the topic of Evaluation and Cost Benefit approaches, Rittel suggested the following titles: *Human Judgements and Optimality* by Maynard W. Sheely, *Social Technology, the Delphi Method* by Olaf Helmer, *Games and Decisions* by L. Duncan Luce and Howard Raiffa, and *Principles of Engineering Economics* by E. L. Grant and W. G. Ireson.

The course assessments included mid-term and final exam and a series of problems loosely based on the structure of the lectures which took students one to two weeks to complete. Assignment topics included: "Design of a Data Bank," "Design of an Evaluation System," "Morphologies: Techniques for the Generation of Ideas," "Cost Benefit Analysis, or Cost Effectiveness Analysis" and "The Semantic Differential."

In 1971, the subject outline and structure changed, reflecting a re-framing in Rittel's approach to design methods. This re-examination solidified threads that appeared in his previous work and text, and focused on the concept of argumentative design. This revision to his initial approach to rational design methods exhibits his growing doubt on systems thinking and signals his conception of a possible "second generation of systems approach," with lecture 4 in 1969 "Knowledge of the Designer," renamed as "Survey and Critique of Systematic Approaches," in 1971.[25]

## Universe of Design Seminar

The Universe of Design Seminar was a series of ten classes devised by Rittel and C. West Churchman. As director of the Social Sciences Program of the Space Sciences Laboratories, Churchman declared that the seminar was based upon the ubiquitous nature of design and the various approaches to design processes from different fields. However an alternative motive for the seminar was based upon the idea that the large scale NASA and military technical solutions could be transferred into civilian and other design areas. As Rittel explained, "It was in the mid-sixties, when the big systems people like NASA were looking for civilian applications in order to have an additional justification for their programs that they began to believe in the spin-offs of their work into civilian use. Among the technologies that they wanted to transfer was the systems approach."[26] A specific amount of the NASA research budget was allocated to the seminar specifically for the purpose of transferring this NASA-generated knowledge.[27] A transcript of the seminar described the purpose behind the course was to establish methods and theories of design in order to look at the role of science and design in developing innovation, with innovation defined as "any act directed to a purposive or controlled change of an object in a specific situation." [28]

The seminar brought together students and staff from across disciplines such as Music, Engineering, Political Science, Art, Architecture, Business Administration and City and Regional Planning. It was during this seminar that Rittel first developed the idea of design as a "wicked problem." The concept would evolve further with collaborator Melvin Webber into the canonical text, "Dilemmas in a General Theory of Planning," first presented as a paper at the American Association for the Advancement of Science in Boston, 1969.[29]

Design problems can be categorised, according to Rittel, as "wicked problems," meaning that they are "unique, ambiguous and have no definite solution." To "resolve" one problem activates a whole new series of other problems which do not contain a finite "true of false" resolution. In many ways this idea is similar to Herbert A. Simon's decision-making strategy of "satisficing," originally posited in *Administrative Behavior* and elaborated upon in a second 1956 paper.[30] However Rittel differed from Simon in that he proposed science could not, in any way, resolve open, dynamic, and ambiguous problems (wicked problems), and that their solution was to be found in creative approaches. His formulation of the wicked problem emanated from the realisation that the initial approach to design systems of the first generation does not work in design problems. Wicked problems were singular in their structure as well as the design process to resolve them.

The only way wicked problems could be solved through a systems-theory approach would be from what Rittel termed "the second generation" of systems theory, which included a model of planning based on an argumentative process, "in the course of which an image of the problem and of the solution emerges gradually among participants, as a product of incessant judgment, subjected to critical argument."[31] It is this second generation approach to wicked problems which would assist Rittel in his next project, the Issue-Based Information System.

## Issue-Based Information System

A 1971 article published in the *Journal of Architectural Education* titled, "Some Principles for the Design of an Educational System for Design," Rittel set out to explain a systems approach toward the architectural design process. Despite the advancements of operation research and mathematical approaches to planning and design problems, Rittel, under the subheading of "Methods Tools and Techniques," claimed that the least developed, but perhaps the most important design aid was the realisation of "social technology." This included a designed framework for social interaction directed toward a clear specified goal, with a crucial transparent and coherent way to display the communicative process which consisted of problems of instruction, forecasting, coordinating expert opinions, organising a group, obtaining corporate decisions, and legislating and implementing solutions. This proposal dissected the design process and its multiple modes of communication with a varied group of participants and attempted to create a visualisation of the communication systems at play. The question in which this social technology attempted to answer in order to complete design challenges included: "how to communicate one's way of understanding to others? How to display one's value-structure?"[32] This problem could be simply addressed graphically, however Rittel suggested that similar to a game, this process would be more successful if the designer could develop rules for instigating controversy and debate, which would reveal hidden weaknesses of any proposal and be founded upon a basis of agreement among participants.

This idea began during his tenure at the College of Design at Ulm, where he concluded that the contrasting dualities of system versus intuitive, rational versus non-rational design processes were weak. Instead of attempting to make what Rittel thought was a useless distinction, he proposed that a better approach would be to understand to what degree design methods should be explained, and to what extent do these design processes need to be clearly presented in order to be understood, criticised, and then improved upon. This method enabled what Rittel termed as the second generation of systems approach, and inherent to this concept is the understanding of design as an argumentative, iterative process with designers arguing with themselves and others to find the most appropriate design outcome. This thinking was also buttressed by the philosophical thought of Karl Popper, specifically his text, *The Logic of Scientific Discovery* (1961). Through his work on the Issue-Based Information System, known as IBIS, Rittel sought to establish a means to explicitly demonstrate the deliberative practice, to understand its logic, formulate a structure, track the arguments during the design process – in essence to deconstruct a course of action which was previously understood to be intuitive, and transform it into an explicit method with a clear structure – in the hope that design and even political decision-making could become more transparent processes.[33] In the end, the IBIS project developed by Rittel were implemented by the German government and by the Organisation for Economic Co-operation and Development.[34]

## Conclusion

At a Teachers Seminar of the Association of the Collegiate Schools of Architecture, Kenneth Frampton praised a presentation by Rittel on a systems approach to the economics of industrialised building. He claimed that "Systematic design" for Rittel "appears to consist of an attempt at the 'societal optimization' of a plan for the transformation of an 'is' state into an 'ought to be state' state. Such a task is deemed to involve the initial establishment of a set of well-defined feasible solutions to which values must then be assigned."[35] Yet he cautioned that in this systems approach, there was a danger of "technical escapism, in a technical idolatry the confusion of means with ends and with the consequent loss of all human value."[36] This fear of technical escapism seems unfounded when Frampton also suggests in the same talk that architects need to think of their role as collaborative and interdisciplinary, and possess "the mental set of a socially aware designer, rather than that of the architect in the old humanist sense."[37] It is difficult to discern, but it may have been this speech by Frampton in 1968 on the dangers of technical idolatry, along with a repositioning of the architect as socially aware, which may have contributed to Rittel theorisation of a second generation design method which included a participatory, interdisciplinary democratic process of user involvement in design decisions and the clear, transparent identification of design objectives and user values.

Rittel's pedagogical contribution to the teaching of architects at the College of Ulm and at the UC Berkeley is a difficult legacy in which to celebrate, since few documents, drawings, or diagrams from his subjects remain. And how does one properly demonstrate, in visual form, the abstract concepts such as cybernetics and information theory, along with rational methods of inquiry? This type of teaching does not really produce the visual stuff of architectural studios, and the operational knowledge taught by Rittel was material that was subsumed by the student and assimilated into their consciousness. As his former students attest, Rittel changed the field of design pedagogy, introduced a rigorous approach to the design decision- making processes which included the mandatory participation of different actors with varying and opposing positions.[38] In many ways the argumentative process was not meant as a stop-gap way for humans to anticipate the rise of computers in rational decision-making, but rather it re-appropriated the input/output function of the computer and assigned the model of engagement as a means to perform as a human-based feedback loop, with decisions being debated and until a solution emerged. Through this research, he introduced in design pedagogy rational methods, interdisciplinary approaches, and tempered scepticism of those rational methods. Moreover he presented the idea that the organisation of information is within the realm of design and "started a line of inquiry which continues today in the field of computer programming and information science – design rationale."[39]

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6 Mantele, "Magicians of Theory," 1.5.

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9 Rittel, "About the Work Hypotheses at the College of Design in Ulm," 1.

10 Rittel, "About the Work Hypotheses at the College of Design in Ulm," 3.

11 Rittel, "About the Work Hypotheses at the College of Design in Ulm," 4.

12 Rittel, "About the Work Hypotheses at the College of Design in Ulm," 4.

13 Rittel, "About the Work Hypotheses at the College of Design in Ulm," 4.

14 Rittel, "About the Work Hypotheses at the College of Design in Ulm," 6.

15 Wolf Reuter, "'… dissolving the dualism between rational and intuitive activity,' Horst Rittel at the Ulm School of Design," in *Ulmer modelle Ulm School of Design 1953-1968* (Ostfildern: Hatje Cantz, 2003), 94-95.

16 Reuter, "'… dissolving the dualism between rational and intuitive activity,'" 94-95.

17 Reuter, "'… dissolving the dualism between rational and intuitive activity,'" 96.

18 Reuter, "'… dissolving the dualism between rational and intuitive activity,'" 96.

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21 Document, titled "Rittel Merit, February 16, 1989, Faculty Records, Rittel, Horst, 1966-1989," Folder III, G. 1, CED archive.

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24 "Impressions of Architecture 130," 2115 -2117.

25 "Impressions of Architecture 130," 2116, 2603.

26 Rittel, "Son of Rittelthink," 1.

27 Rittel, "Son of Rittelthink," 1.

28 Transcript of seminar, Horst Rittel, "The Universe of Design," Faculty seminar, Berkeley, University of California, Institute of Urban and Regional Development, Spring 1964, 2.

29 The paper would ultimately be published in *Policy Sciences* 4 (1973): 155-169.

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31 Horst W. J. Rittel and Melvin M. Webber, “Dilemmas in a General Theory of Planning,” *Policy Sciences* 4, no. 2 (June, 1973): 162.

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36 Frampton, “Reflections,” 39.

37 Frampton, “Reflections,” 39.

38 Rittel, “Son of Rittelthink,” 1; Rith and Dubberly, “Why Horst W. J. Rittel Matters,” 72-74; “Impressions of Architecture 130,” 73.

39 Rith and Dubberly, “Why Horst W. J. Rittel Matters,” 72.