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Chapter 6

Design Studios as Method for Exploring Complex Challenges in the Pearl River Delta



Daniele Cannatella and Steffen Nijhuis

Abstract This chapter draws on three different design studios that focus on the Pearl River Delta to discuss what kind of knowledge has been generated within them, and how they can be used systematically as a method to address the region's complex challenges. The three studios differ in their objectives, duration and structure, but are linked by a research-through-design approach. A selection of some illustrative outcomes is presented and structured around three types of knowledge—project based, form based and idea based—which is typically produced in the design process. This knowledge refers to four main aspects through which it is possible to describe the complexity of the urban landscape, namely time, space, causality and materiality and can be either contextual or generic. Nonetheless, within a design studio, it can be systematically employed to support research activities, speeding up the development of research programmes dealing with complex issues, such as adaptation of fast urbanising deltas.

Keywords Research through design · Complex challenges · Design studio · Spatial design education

6.1 Introduction

In landscape architecture, as in other disciplines dealing with spatial issues, spatial design is a key activity for investigating the transformative potential of the urban landscape and exploring solutions to enhance its capacity to cope with the increasing uncertainty arising from the combined action of climate change and urbanisation.

Spatial design as a research strategy—often referred to as *research through design*—is a valuable way to address wicked problems such as climate adaptation

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in urban systems (Nijhuis and Bobbink 2012; Roggema 2014). When framed as a research activity, spatial design entails searching for and generating new knowledge through the conception, implementation and execution of a plan. This is a creative process, outlined by coherent goals and structured around clear means of achievement (Nijhuis and de Vries 2019) to coherently and holistically address the complexity arising from the multiplicity of social, cultural, economic, spatial, ecological, administrative and organisational instances and the mutual relationships they establish among themselves (Klaasen 2004). In turn, this multitude of systems forming the urban landscape has distinct spatial domains and is marked by different evolutionary trajectories that require solutions aimed at their synchronisation over time (Meyer and Marchand 2015).

For this reason, the ability to establish a constant and fruitful dialogue amongst different disciplines, sectors, stakeholders and decision-makers is a prerogative of spatial design, as it sets the common ground for actors from different backgrounds and having different interests to take joint action in pursuing shared visions towards more desirable futures. At the same time, it demands the systematic implementation of approaches, methods, strategies and tools that can ensure a high degree of flexibility to operationalise such visions.

In this perspective, design studios are at the core of learning and education in spatial design disciplines, as they provide students with structured guidance and scientific rigour, while simultaneously offering a free environment where to spawn new knowledge through the active stimulation of creativity and invention in investigating and unravelling possible futures by means of design (Hinterleitner et al. 2021).

In addition to their pedagogic importance, design studios are a valuable resource for the research field. As Armstrong (1999) pointed out, they constitute ‘valid peer-reviewed research which contributes to the scholarly growth of spatial disciplines, adding to the general body of knowledge’, particularly when employed as a tool to investigate a broader research problem. In such circumstances, they act both as a stimulus to the research process or as a trigger to initiate research.

The outcomes produced in such a particular setting are manifold. They can be used to understand the conditions under which landscapes have developed in a specific way; can address specific solutions to the spatial challenges that characterise a specific socio-ecological context; or can serve as an inspiration, stimulating reflections and critical thinking on the design process itself.

However, what kind of knowledge do they generate, on what aspects, and in what form? What are the conditions for which this knowledge can be systematically integrated into research?

This contribution addresses these questions making use of the outcomes of three design studios connected or related to the Pearl River Delta (PRD). The three studios are different in terms of topics, goals, setting and duration. Nonetheless, they share the main premises and the overall design-oriented approach. They all look through different scales simultaneously, in order to connect them through the development of coherent, scalable and replicable design principles. Applied to the PRD, this implies a view that ranges from the regional scale—in addressing the urbanised

delta both as an administrative/economic entity, influenced by global dynamics, and a physiographical unit, as a deltaic landscape—down to the local scale, where the spatial, ecological and social implications of design choices materialise and people can experience them through their senses.

Furthermore, they are structured according to a multidisciplinary approach, with a strong interconnection among landscape architecture, regional design, urban design and planning fields.

This contribution elaborates on a selection of the outcomes of the design-related strategies developed within these studios, to reflect on the added value the latter have in producing systematic knowledge that can be beneficial for research. The article is structured as follows: Sect. 2 discusses the value of design studies in the teaching of spatial disciplines as a form of work; Sect. 3 introduces the three design studies related to the AUT project; Sect. 4 elaborates on the type of explorations carried out and the outputs generated in different contexts; Sects. 5 and 6 discuss the results and the implication of the findings.

6.2 Design Studio as a Work Form

In landscape architecture and urbanism education, design studios are powerful tools enabling students to explore ideas and produce spatial designs while generating particular forms of knowledge that can be specific to the context addressed within the studio or generic.

A design studio as means for education in landscape architecture offers multiple benefits, for both students and tutors. Firstly, it recreates the conditions and dynamics of professional practices in a relatively safe, student-centred environment, constituting the ideal bridge between academic training and working life; secondly, within a design studio, students are stimulated to deal with real-world issues and challenges, elaborate and critically evaluate spatial solutions and strategies that can find an application in a given real context; finally, design studios often offer the opportunity to interact with real stakeholders and professionals through workshops and presentations, challenging students to present their ideas in a clear, concise and persuasive manner. These conditions ensure constant learning and reflection throughout the whole design process throughout the duration of a studio.

Dynamic working, problem solving and interaction with experts are the elements of the typical setting of a design studio that serve as inspiration for the students. Such setting offers the ideal environment where pupils' imagination, creativity, fantasy and invention are encouraged and guided. Through a constant feedback loop between research and design, students' knowledge is broadened, enabling them to expand and refine their thinking, to create new relations between what they know and what they learn and consequently master the products of their fantasy (Munari 1998). In this regard, the free and informal environment that a design studio provides allows students to test their skills and step out of their comfort zone, use different methods and tools, and develop new design approaches, ideas and concepts.

Moreover, the design journey within a studio is not a solitary act. The knowledge of the people involved is put into system through a co-creation process engaging pupils and mentors since the studio's early stages, to generate shared perspectives and trajectories. This represents an added value for the learning process, as besides the professional experience and the acquisition of specific technical expertise students can develop fundamental 'soft' skills ranging from the ability to work in a team—the division of tasks and time management—to the communication of design choices and argumentation of their project.

Lastly, design studios provide the opportunity for experimenting new design approaches and techniques, as well as teaching methods. Instructors take part in all respects in the design team, acquiring different roles—as mentors or more experienced colleagues—playing a more interactive role and sharing knowledge not only on a theoretical level, but also on a practical one. Teachers structure in a reasoned manner activities and tasks envisioning ideal end products and outcomes that have to be delivered in a limited time. These activities are planned through a programmatic series of meetings, workshops and presentations over a timeframe that can span from a few days to several months to generate insights through design and integrate the results into broader planning and policy-making processes.

When framed in such fashion, design studios can be easily combined with research, following the idea of research through design. This process typically follows the research-by-design's three-phase structure (analysis-synthesis-evaluation) bringing about knowledge that can be integrated as part of a larger research programme (Armstrong 1999). Acting as arenas where students and tutors work together in a research partnership, to investigate problems and generate speculative ideas through a design process, exploring propositions on both the physical and social domains, to render them into abstract forms.

In a design studio, the knowledge of all those involved is brought into a co-creation process in an early stage, to produce common perspectives and structure design research. The latter involves the systematic investigation of strategies, procedures, methods, routes, tactics, schemes and modes through which people work creatively. Design involves the testing of ideas, materials and technologies. It involves innovative conceptual development, product evolution and market modification. It also involves research into cultural, social, economic, aesthetic and ethical issues (Strand 1997).

6.3 Three Design Studios on the Pearl River Delta

This section presents three different design studios, all of which have the PRD as their objective of study. The studios are characterised by different disciplinary outlooks, although inevitably the topics addressed within each of them overlap. The adaptive urban landscape graduation studio offers a privileged investigative perspective on the role that the landscape plays in suggesting spatial strategies and solution enabling the conditions for sustainable urban development in the PRD. The Globalisation studio has a strong focus on spatial planning and social justice; whereas the Pazhou Island

Table 6.1 Design studios

Design studio	Main topic(s)	Duration	Spatial scales
Adaptive urban landscape graduation studio	Landscape-based regional design; adaptive urban transformation	1 year	From regional to district
Globalisation studio	Globalisation; spatial planning	10 weeks	From regional to district
Pazhou Island design workshop	Landscape and urban design	1 week	District

design workshop revolves around the urban design assignment for the Pazhou district, in Guanzhou. The three studios differ on topics, scale of investigation and design output (see Table 6.1). Nonetheless, in all three cases, the PRD serves as an exemplary case for the complexity of the spatial challenges it presents to designers from many points of view: the economic development ambitions of this deltaic region make it one of the most vibrant areas in the world, in constant and swift transformation. At the same time, the most pressing questions revolve around the most pressing urgencies revolve around the impact of human activities on a vulnerable territory, on which the effects of climate change are being increasingly felt. Furthermore, in each of them participants were asked to investigate how spatial transformations at different scales can offer safe and quality spaces and without neglecting the environmental, historical and cultural values that characterise the whole delta. The following subsections briefly describe the objectives and settings of the studios.

6.3.1 Adaptive Urban Landscape Design Studio

The adaptive urban landscape design studio was set to explore landscape-based design approaches for adaptive urban transformation in fast urbanising deltas, making use of the PRD as a case study. The studio relied on design as a research strategy to explore landscape architecture principles for climate adaptation, social inclusion, industrial and agricultural heritage redevelopment and ecological restoration through an integral approach among governance, knowledge development and spatial design. The studio is part of the Flowscape MSc graduation studio at TU Delft within the Landscape Architecture master track (Nijhuis et al. 2012; Nijhuis 2020, 2021).

Within the studio, students were free to choose their topic depending on their interest to develop their project over a year. They kick-started their individual research projects by framing a set of research questions aiming at (1) defining the natural, economic and cultural factors and conditions that have led to a certain type of development of the urban landscape over time and through different spatial scales, as well as the relative challenges that need to be addressed; (2) understanding the relevance of nature-based approaches and solutions, exploring design principles that can fit to the context; (3) testing the effectiveness of latter in the PRD context by translating

them in the form of spatial design assignments; and (4) reflecting on the lessons learned through the application of the design experiments, their relevance and their replicability in other contexts.

Within such framework, design principles were derived through the investigation of both theory and practical cases, based on the review of relevant literature in the field of landscape architecture and exemplary international case studies. Experiments were conducted throughout the whole graduation work, using real-time cases and sample areas and shared in dedicated workshops in which students could present their progress and findings and receive feedback from peers and tutors.

6.3.2 *Globalisation Studio*

The MSc elective studio on regional design ‘globalisation’ is a joint programme of Delft University of Technology (TUD), faculty of Architecture and the Built Environment, Department of Urbanism and the Polytechnic University of Hong Kong PolyU Design, supported by the International Forum of Urbanism (IFoU).

The main goal of the studio was to develop inclusive spatial approaches, concepts and strategies jointly addressing socio-economic and environmental challenges to draw possible future planning scenarios for the PRD as a global economic player.

The outcomes of the studio fall mainly within the domain of spatial planning, but at the same time are thoroughly entangled with landscape architecture and urban design, in an interdisciplinary fashion. Students worked in groups of four to build a sound theoretical framework with the aim of investigating the current regional trends in the light of globalisation and metropolitanisation of the delta and develop spatial visions at the regional scale for the future development for the area.

The unfolding of spatial visions was supported by the development of analytical frameworks and subsequently accompanied by the definition of strategic goals and actions addressing different contexts, ranging from urban to rural areas. The measures proposed were structured according to timelines and accompanied by stakeholder analysis.

6.3.3 *Design Workshop on Pazhou*

The design workshop on Pazhou, held in Guangzhou in 2019 and hosted by the South China University of Technology (SCUT), was organised within the AUT project. The aim of the workshop was to develop a spatial vision based on a landscape approach for the Pazhou Island. Pazhou is a sub-district of Haizhu, in south-eastern Guangzhou, that is today part of the city’s downtown area. The area hosts the Guangzhou International Convention and Exhibition Centre, as well as rural and fishermen villages and cultural heritage such as the Pazhou Pagoda, built in 1600. For its proximity

to the central business district (CBD), Pazhou has been redeveloping as high-end commercial, residential and offices areas (Shin 2016).

The workshop, lasting five days, was supported by various activities, such as site visits and lectures held by professors, researchers and local administrators on both theoretical approaches and the state of regional and local planning in the PRD.

Master's students, PhD Students and researchers from the three universities part of the AUT consortium were organised in groups of five to six people and worked together to develop masterplans in the form of drawings and sketches, starting from a set of analytical maps on the main systems (e.g. water, landscape, topography, mobility, land use, urban functions) existing in the area. The designs were used to test a set of adaptive principles on stormwater management and riverine flooding protection, that could support preserving enhancing the elements of cultural value in the area. Ultimately, each group presented their findings to other participants to receive feedback.

6.4 Results

In this section, the outcomes of the activities carried out in the above-mentioned design studios are gathered according to the nature of the different explorations and used as examples of what kind of knowledge is generated through them. For this purpose, the latter are clustered here according to three types of design explorations (cf. Nijhuis and de Vries 2019): project-based, form-based and idea-based explorations. Each of these explorations address four major overarching blocks related to both spatial design process and narrative, namely space, time, causality and materiality. These are the main blocks through which the knowledge produced in addressing the complexity of the PRD urban landscape.

6.4.1 *Project-based Explorations*

Project-based explorations have privileged view of the context under study. These approaches investigate and describe the spatio-physical, ecological or cultural features characterising a territory. The main purpose of the adaptive urban landscape studio was the exploration of landscape-based approaches for adaptive urban transformation in the PRD. For this reason, the first step carried out by the students required the understanding of both the natural and anthropogenic systems that make up the urban landscape in the delta.

This implied the investigation of the current spatial and physical configuration of some of these systems (e.g. the water system, mobility network, land use), which in turn was an essential step for the subsequent elaboration of tailor-made design principles to increase the adaptive capacity of the urban landscape to counteract and mitigate the impacts of flooding. This kind of analysis, which takes shape in the form

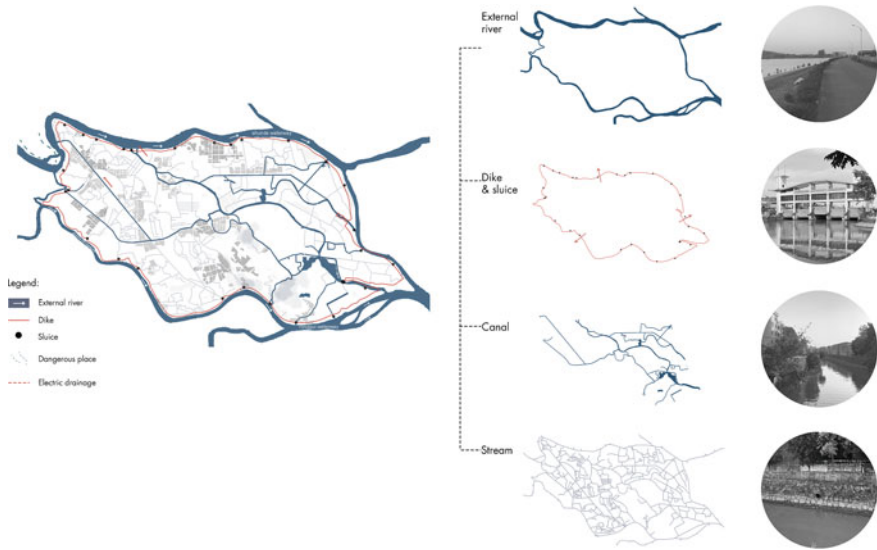


Fig. 6.1 Existing water management system in Shunde district. *Image* Yijing Li, TU Delft

of descriptive maps, is fundamental to understand the functioning of the site, identify the areas vulnerable to flooding and pinpoint those with high transformational potential that can play a role in the structuring of green–blue networks, as in the case of Shunde (Fig. 6.1). Shunde is located in the hinterland of the PRD and suffers from waterlogging by rainfall due to the uncontrolled industrialisation and increasing soil sealing.

Here, the water management system has been decomposed in multiple layers depicting the main waterways surrounding the study area, the flood defence system, made out of dykes and sluices protecting from and regulating the water flow and the main canals and streams crossing the site. In the main map, these layers are superimposed on the urban system to investigate the spatial relationships among water and the urban environment. In this way, it has become easy to discern the current state of the water system, the degree of continuity and connectivity of the blue network, the spatial distribution and the hierarchies among the different natural and urban elements.

This kind of knowledge can be complemented with the temporal analysis on the co-evolution of specific systems (Fig. 6.2).

In this example, the development of the urban areas is taken as the object of investigation in relation to the water system in specific periods from 200 AD to the present day, highlighting the increasing reduction of the amplitude of the river pattern due to urbanisation in Guangzhou, especially from the 1980s. Looking at this series of comparative temporal maps, it is easy to reconstruct how the urbanisation process has in fact altered the natural structure of the water network, especially since the 1980s, when the economic reforms initiated.

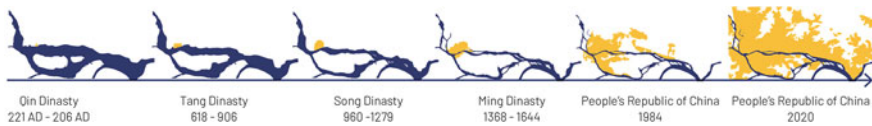


Fig. 6.2 Historical timeline of the water and urban systems in Guangzhou. *Image* Margherita Ghini, TU Delft

6.4.2 Form-based Explorations

Form-based explorations aim to visualise, test and evaluate design choices through the development of proposals and their consequent assessment with respect to functional, socio-cultural, ecological and aesthetic impacts. In this regard, visualisation plays a prominent role. Within the three studios, drawings were developed in the form of diagrams, landscape representations, sections and bird's-eye views. In this regard, these visual devices are not for their own sake. Rather, they support the understanding on how the resulting spatial configurations look, and how they would behave under different circumstances, for example under the shifting water levels and climate conditions (Fig. 6.3).

This sheds light on the effectiveness and flexibility on the elaborated solutions, by taking into account the temporal cycles and processes of natural systems to evaluate the capacity of the proposed design to cope with the uncertainty arising from climate change and allow for adaptation to different flooding scenarios.

In a similar fashion, masterplans and sections support the knowledge of how spatial solutions are translated and materialised into space, and what opportunities they provide to enhance environmental, social and economic processes.

Figure 6.4 shows how four layers of investigation (water, industrial transformation, mobility and public space) are integrated into one system, resulting in a new industrial park where the water network is redesigned to restore the ecological values of the site, and the existing facilities are given a new meaning through their reuse. By applying adaptation principles such as water collection, water purification and water reuse, water retention capacity of the area is enhanced, while at the same time the newly created park provides several functions and programmes grafted on different landscapes where people can experience nature and witness the historical traces left by industry.

Sections for water collection, water purification and water reuse (Fig. 6.5) show how topography, water, vegetation and the open space work together in supporting water management and what is the resulting final landscape, providing a hint of how the succession of spaces works, what types of edges exist in proximity to water features, patterns of vegetation serving multiple ecosystem services and their spatial relations with the built environment.

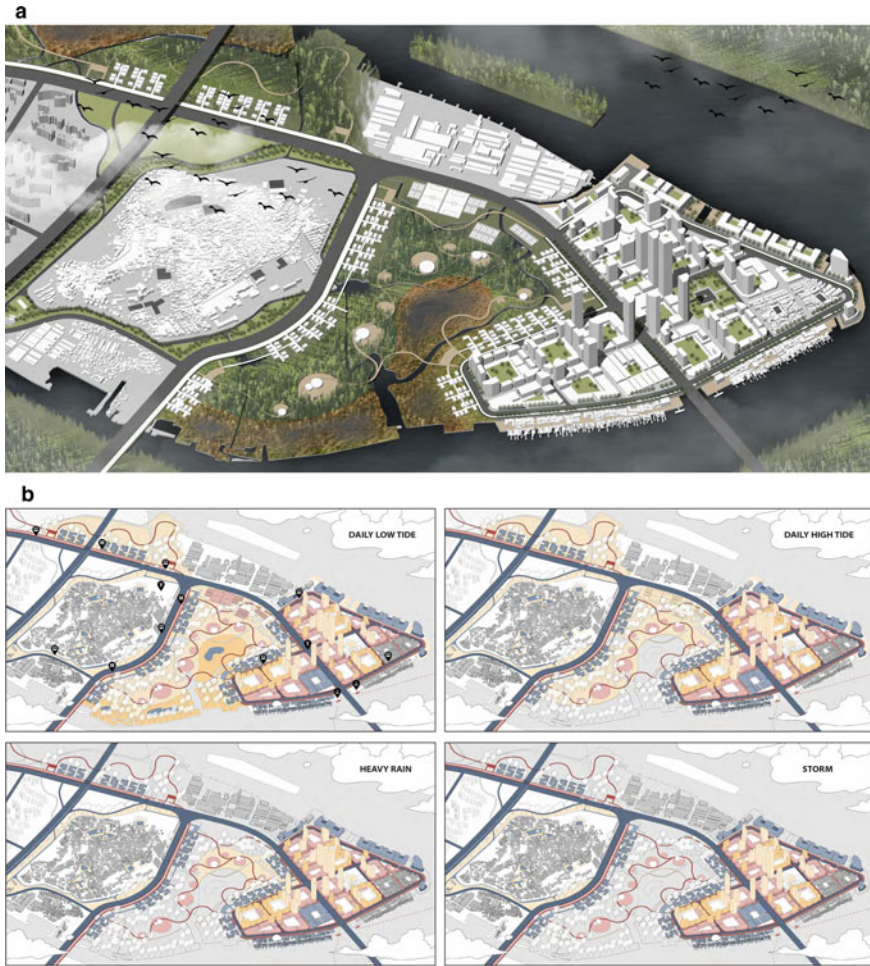


Fig. 6.3 a Bird's-eye view of the proposed masterplan for the eastern side of Pashou Island; and b diagrams showing how the site changes with changing water levels and climatic conditions. *Images* Jiayun Wu, TU Delft

6.4.3 *Idea-based Explorations*

Explorations based on ideas may be strategic or conceptual. In strategic explorations, the problem is structured and addressed by proposing feasible solutions; conceptual explorations, on the other hand, are characterised by more speculative approaches that may seek extreme conditions or be driven by imagination and poetics. For instance, within the Globalisation studio, students were asked to formulate a vision for the PRD towards 2035. Unlike the adaptive urban transformation studio, the main focus was on the sustainable socio-economic development of the delta. Therefore,



Fig. 6.4 Masterplan for the proposed industrial park in Shunde. *Image* Yijing Li, TU Delft

spatial strategies entailing economic and functional relationships in the urban environment have been developed, supported by plans structured around feasible actions and policies to be implemented.

The development of a phased time plan is helpful in determining how the identified strategies may unfold over time to meet the envisaged overarching objectives (Fig. 6.6). This helps to elucidate how the proposed strategies may work together, what synergies may emerge both in space and time, and what potential conflicts or impediments may arise in achieving the final objectives. Furthermore, it supports the definition of priority actions and policies to be implemented to initiate transformation processes and those without which the plan cannot be further carried out.

Drawing and sketches have been employed to visualise how certain policies proposed on a larger scale can be translated into smaller-scale designs, generating positive impacts on the quality of the built environment. Figure 6.7 shows how a street lacking maintenance and sense of identity (on the left) can be transformed through simple interventions, such as planting trees along the road, repaving it and adding tourist activities in place of abandoned workshops in an urban village.

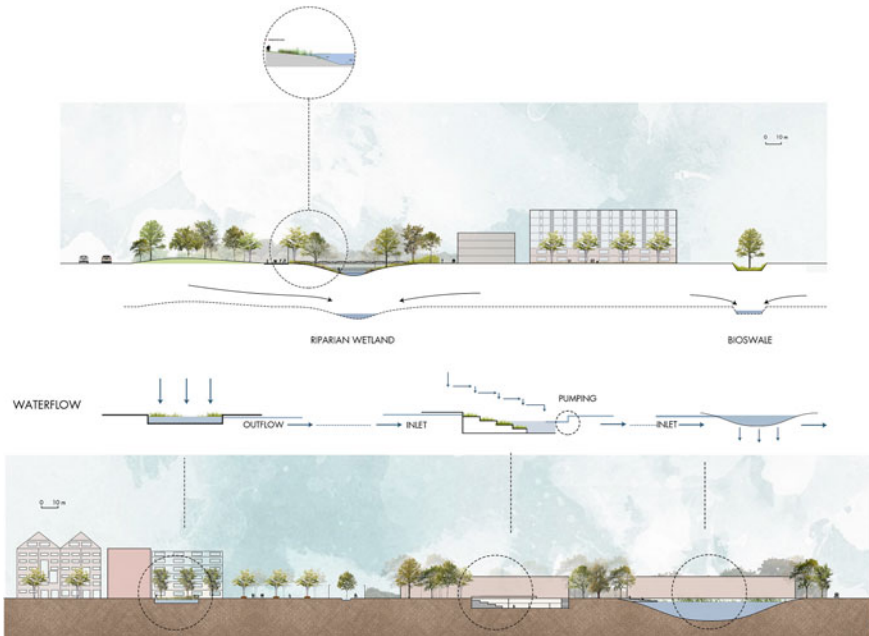


Fig. 6.5 Sections for water collection, purification and reuse for the proposed industrial park in Shunde. *Image* Yijing Li, TU Delft

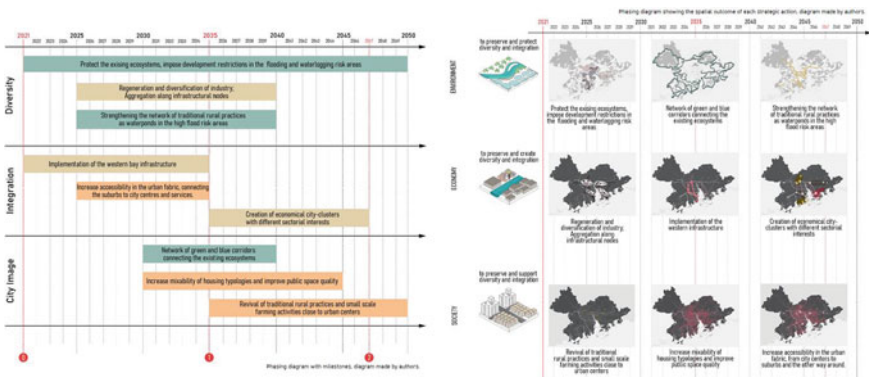


Fig. 6.6 Diagram showing the phasing of strategic actions. *Image* Nadya Chabayeski, Patrick Maurer, Pingyao Sun, Keyan Tang and Bowen Yuan, TU Delft

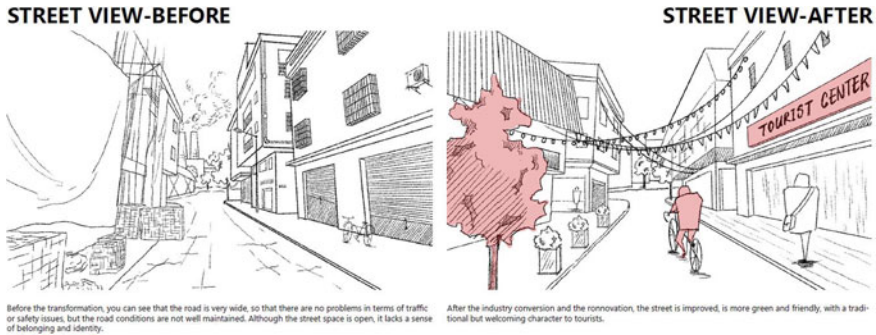


Fig. 6.7 Sketches showing how a road changes after the proposed interventions. *Images* Yan Liang, Isabella Trabucco, Francien Fons, Yuru Chou and Xinqi Yao, TU Delft

6.5 Discussion

The examples presented in this chapter show how design studios can facilitate the production and sharing of new knowledge in different forms through a research-by-design approach.

This sort of knowledge, belonging to the designer's culture, is produced within a studio and becomes an integral part of the design process taking shape through different explorations. It is translated into spatial visions, proposals, strategies and solutions which in turn are supported by original methods and tools and based on the ability to conceive socio-ecological structures and processes embedded in space.

However, to be used systematically in research, such knowledge must be explicit, debatable, transferable and accumulable (Manzini 2009). In other words, it must be communicated in a clear and transparent manner and made available to anyone interested in discussing it; it must provide conceptual and operational tools for other designers who want to apply it and must be the point of departure for other researchers willing to produce further knowledge.

To meet these criteria, design studios must be set up to promote a scientific approach in the knowledge production process. This entails keeping a certain degree of generalisation, where selection and reduction processes are necessary to describe and interpret the systems through which the real world is decomposed, to define similarities and/or peculiarities of a given context; furthermore, reflections and considerations are based on a deliberate thought process where relations and conclusions are drawn consciously and logically (Klaasen 2004; Huisman 1996) and are shared to be subjected to verification/falsification.

In this sense, even a design workshop condensed into a week's work, such as the one on Pazhou, can generate stimulating results which can be used as input in a broader research. The work carried out in parallel by the different groups and presented in a plenary session managed to quickly create a consensus on which spatial, cultural and ecological instances are to be taken into account in the design process.

Fig. 6.8 Presentation and deliberation of ideas through schematic drawings at the conclusion of the Pazhou Island workshop. *Photo* Daniele Cannatella



Most of the projects aimed at preserving the fishing villages along the Huangpu-chong River, on the southern bank of the island, and at creating water retention areas connected to the water network on the site. Some other design principles, such as softening the edges of the riverbanks, have found their place at various points along the borders of the island. The same applied to urban development, which each group interpreted differently. The presentations then generated a debate on where and how best to build on the site, and for what reason (e.g. densification versus preservation of green areas; favouring ecological processes versus finding the most appealing areas for developers, etc.) (Fig. 6.8).

Throughout the process activated within a design studio, rationality and creativity are totally complementary, with creative intuition acting as a trigger enabling scientific discovery and scientific rigour channelling creativity to enhance and exploit the innovative aspects of the act of designing.

The outputs of the three design studios are manifold: they range from analytical drawings and synthesis schemes to design strategies, concepts, design principles, masterplans or guidelines which aim to provide answers to the leading research questions. The latter may be overarching, specific to the context or thematic. Either way or in analogy with the type of explorations, these can be grouped into three broad categories of knowledge, as depicted in Table 6.2: project-based knowledge, form-based knowledge or idea-based knowledge (Nijhuis and de Vries 2019).

Project-based knowledge has to do with the context and focuses on understanding the conditions (environmental, socio-economic, functional, political and so on) that determine the nature of the project. In the case of Shunde, for example the analysis of the water system determines the critical areas on which to intervene in order to redesign a continuous blue network to which a system of green, permeable spaces can be pivoted to guarantee a greater buffer capacity for water, connecting the existing open spaces to the areas that can potentially be redeveloped.

Form-based knowledge implies the ability to realise and make judgements about the spatial qualities of the projected urban landscape, but also on how the latter

Table 6.2 Types of knowledge (Nijhuis and de Vries 2019, adapted from Grocott 2010)

Project based	Situational	Engaging in deliberation concerning the legal, political, cultural, functional, economic and ecological context of the design task.
	Integrated	Creating a synthesis of contradictory interests, changing restrictions and conflicting agendas while working with various actors, applying diverse methods and operating in a variety of fields.
Form based	Visual	The development, fabrication, proposal and translation of ideas into words and images.
	Material	The assessment, exploration and realisation of qualities of urban and landscaping schemes and technical constructions, in consideration of the aesthetic, functional and ecological consequences of design choices.
Idea based	Conceptual	The production of ideas and proposals with space for poetic and speculative approaches that promote imagination and unexpected proposals.
	Strategic	The assessment of the situation and the creation of future plans; the problem is structured and defined based on the feasible solutions that have been proposed.

changes with changing circumstances. In a way, it is an exploration of how a given spatial configuration behaves in different scenarios. When it comes to adaptation strategies, it means testing design choices against changing water conditions, as in the case of the project on the Eastern side of the Pajou Island developed within the adaptive landscape transformation studio.

Idea-based knowledge can be either strategic or conceptual. In the first case, the understanding and assessment of the initial conditions is preparatory to the development of a plan that can dictate the directions of spatial development, but also how this may occur over time. This kind of knowledge becomes even more relevant in the light of increasing uncertainty due to the unpredictability of climate change impacts on urban systems, in supporting the investigation of what social, economic, ecological and climate conditions are necessary for the proper implementation of a plan, and how to build (or avoid when possible) the right circumstances through actions and policies linked to each other, according to a logic of incremental development.

All findings produced within the framework of the studios contributed to stimulate and steer strategic discussion directly related to the AUT project, whether they were proposals to be developed and integrated into the development of specific projects, approaches supporting the understanding of the state of the art and the implementation of design ideas, or design tools for the adaptation of the deltaic landscape of the PRD.

6.6 Conclusion

Although very different in their objective, structure, spatial scales addressed and duration, the three design studios presented in this contribution share a common thread that unites them and gives food for thought on the way in which designers address the complexity of urban systems through spatial design.

Firstly, in their attempt to grasp and address the reality in which the students were confronted, the kind of knowledge generated within the studios were led by research intentions focusing on the development of design solutions that find an application in the PRD context (specific knowledge) or it was derived from the meta-analysis of multiple studies (generic knowledge). Either way, design studios provided students with a structured guide to knowledge generation. This occurred at all stages of the design: from data collection and interpretation to the investigation of possible design alternatives and their subsequent evaluation.

Space, time, causality and materiality are the four guiding 'blocks of thought' through which students as young professionals are challenged to think, describe and intervene on the real world.

Secondly, a well-formulated research question helped students throughout the whole design process. Formulating sharp research questions serves to narrow down the research scope, to guide information gathering (i.e. to define the spatial and temporal scales worth investigating and their resolution), to understand processes and relationships between systems and elements (i.e. to designate and prioritise cause-effect dynamics and define challenges and opportunities arising from such interactions), and to support the development of plans and perspective for action. However, especially at the beginning of a workshop, this exercise can be puzzling for students. Group presentations and feedback from peers and tutors can give them a helping hand to start the design process, which in turn is a feedback loop constantly subject to adjustments and reduction.

Thirdly, the knowledge generated at the different levels (based on designs, forms, and ideas) is highly interconnected. Solutions that respond to a specific context are to some extent abstractable, as long as the defined criteria are made explicit and the conditions under which the approaches, methods and tools used can be replicated are clear. In complex areas such as the PRD, due to the multiplicity of spatial scales, landscapes and actors, this aspect is crucial to reflect on the extent to which certain plan choices, principles and implementation strategies can be upscaled or replicated in other areas of the region presenting similar characteristics to the case study used.

Finally, the systematic knowledge generated throughout the studios an support research in several ways: on the one hand, it enables the validation and refinement of both analysis and design methods, as it provides several practical cases on which to test them. On the other hand, the possibility of sharing and discussing tangible outcomes supported by drawings, schemes, models and diagrams makes it easier and faster to create common ground for different perspectives, speeding up the development of research programmes dealing with complex issues, such as the adaptation of fast urbanising deltas.

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