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Rob Roggema[ab], Lisa Vos[c] & John Martin[d]

[a] Van Hall Larenstein University of Applied Sciences, Velp, The Netherlands

[b] Centre for Design Innovation, Swinburne University of Technology, Hawthorn, Victoria, Australia

[c] Lisa Vos Consult, Wageningen, The Netherlands

[d] Centre for Sustainable Regional Communities, La Trobe University, Bendigo, Australia

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Rob Roggema[a,b]*, Lisa Vos[c] and John Martin[d]

[a]*Van Hall Larenstein University of Applied Sciences, Velp, The Netherlands;* [b]*Centre for Design Innovation, Swinburne University of Technology, Hawthorn, Victoria, Australia;* [c]*Lisa Vos Consult, Wageningen, The Netherlands;* [d]*Centre for Sustainable Regional Communities, La Trobe University, Bendigo, Australia*

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This article proposes a new theoretical framework that supports the preparation of local communities to deal with climate impacts. In this framework, derived from the metabolism model, the resources that form the input (social capital and practical conditions) for design charrettes are processed to deliver output resources in the form of enhanced and sophisticated spatial design propositions, which are more resilient en adaptive. Elaborating this model, processing input to deliver desired outputs can only occur when deep learning experiences are offered to the local community. The framework is used and tested in two case studies in northwest Victoria, the City of Bendigo and town of Sea Lake. The findings from the study show the performance of the framework and the improved properties of the design propositions. Conducting design charrettes has two effects. New ways of collaboration are explored allowing exchange to happen between community members with different interests. This leads to new social constructs that are capable of achieving results that would be otherwise impossible or unknown of. Secondly, the design propositions suggest highly resilient and adaptive spatial transformations in the city or town.

Keywords: design charrette; metabolism; climate adaptation; resilience; social learning

1. Introduction

When dealing with climate change topics, local communities are often confronted with uncertainties, the global level of the problem and a lack of resources. In this article, we present a theoretical framework for *resourcing* local communities to become more climate resilient through collaborative design. We take the urban metabolism model (Newman 1999) with its resource input, processing, and waste outputs as the mold to shape our framework. We view resources both as a source (e.g., input in the process) and products (e.g., output of the process). Further, we distinguish two types of resilience, which can be linked to the inputs and outputs, social and physical resilience (Roggema et al. forthcoming), respectively. Increasing social resilience is considered to occur mainly at the beginning of collaborative design processes. Beforehand, building and identification of network resources takes place as well as making sure the right conditions for a successful process and facilitation are taken care of. These shape the input of the collaborative process. During the design charrette,[1] (social) learning occurs and this is considered to be productive both for increasing social resilience and having a positive impact on physical resilience. As output of the collaborative process, we consider physical resilience to be increased as a result of designs and physical-spatial propositions leading to resilient and climate adaptive urban precincts and landscapes.

In this article, we point out the importance of making use of both input and output resources, creating both social and physical resilience, as a prerequisite to improve (social) learning in communities and result in more adaptable spatial futures. The article is divided into two parts, the theoretical framework and the case studies. The theoretical framework, network theory, social constructs and conditions, and social learning and design charrettes will be described in the first part. Two case studies in Victoria, Australia, exemplify the framework in the second part. The article ends with a discussion and conclusion.

2. The theoretical framework

The basis for the proposed theoretical framework consists of two types of resilience: social and physical (Figure 1). The physical component reflects basically the planning methodology. In dealing with climate impacts, current planning practice is rarely flexible enough to include unexpected and sudden change, occurring at an unknown moment in the future. Therefore, a novel methodology, Swarm Planning, has been developed. This was necessary because to date the adaptive capacity, which is extensively discussed elsewhere (see, for instance, Brooks et al. 2005; Adger et al. 2007; Parry et al. 2007), of urban environments and communities has been acknowledged as too low and the resilience of socioecological systems (Berkes et al. 2000, 2003; Walker

*Corresponding author. Email: rob@cittaideale.eu

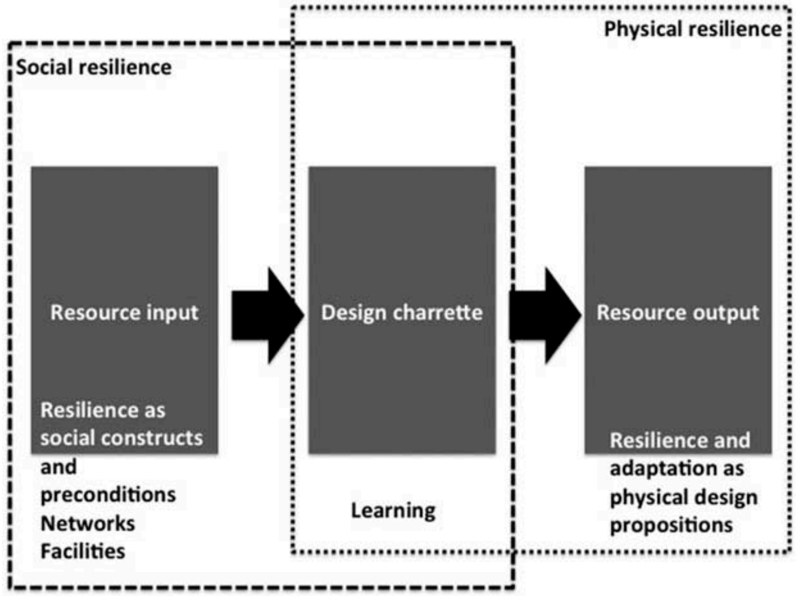

Figure 1. The theoretical framework.

et al. 2002, 2004; Anderies et al. 2004; Folke et al. 2005; Folke 2006; Young et al. 2006; Brandizio et al. 2012) was long explained from a resistance point of view because it was too difficult to deal with uncertainty, especially in relation to climate adaptation (Dessai & Hulme 2007; Dessai & Van Der 2007; Kabat 2008; Mearns 2010; Meyer 2012) in a clear society. Engineering, measurable solutions were the result and spatial planning has long been unusable to incorporate uncertainty in its practice because it has been a government-dominated operation, as schools of planning subsequently have described from incrementalism (Lindblom 1959), post-positivism (Allmendinger 2002), communicative planning (among others, Habermas 1987, 1993; Healey 1997; Innes 2004) and agonism (see Mouffe 1993, 2005; Hillier 2003; Pløger 2004). Only recently scholars make an appeal on dealing with uncertainties by introducing unsafe planning approaches (Davy 2008; Gunder 2011) in which self-organization of planning stakeholders determines the result rather than the regulations of the government (Roggema 2012a). This novel methodology, Swarm Planning (Roggema & Van Den Dobbelsteen 2008; Roggema 2012b, 2012c), emphasizes a shift from the technical paradigm, in which every problem is solved in a mechanical fashion, to an organic paradigm, which allows for more dynamic open-ended solutions (Brouwer 2011; Broess 2012). Swarm Planning does not resist change with technical measures but it anticipates change whenever necessary, such as practiced in *Building with Nature* projects, which benefit from natural processes in order to improve (coastal) safety (De Vriend & Van Koningsveld 2012). These nourish beaches instead of fortifying coasts (Inman 2010).

Social resilience emphasizes community involvement in designing and deciding about their own future. Several aspects of community-based planning (Cleaver 1999; Forester 1999; Beierle & Konisky 2000; Matthies & Krömker 2000; Umemoto 2001; Lane & Mcdonald 2005; Lange & Hehl-Lange 2005) reflect the social side of resilience, such as social learning, mapping of social networks, and community participation that all underpin the successful conduct of future planning in design charrettes.

The theoretical framework considers as the input for learning in the design charrettes social aspects of resilience, while the output delivers physical resilience. This positions the design charrette as the core component in a metabolism model to and from which streams of knowledge, development, and resilience types flow. The concept of urban metabolism (Wolman 1965) analyzes cities through the quantification of inputs – water, food and fuel, outputs – sewage, solid refuse, and air pollutants and tracks their respective transformations and flows. This model has further been extended (Newman 1999) and elaborated by many (Newman et al. 1996; Newton 1997; Newton et al. 1998, 2001; Newman 2006; Niza et al. 2009; Minx et al. 2010). Odum (1983) used an analogy of electrical energy networks to model the energy flow pathways of ecosystems to develop a systems approach, thinking in sources, production, consumption, and losses. This inspired many to apply this language to consider the city as an ecosystem. The city is conceived as a dynamic and complex ecosystem. The social, economic, and cultural systems cannot escape the rules of abiotic and biotic nature. Guidelines for action will have to be geared to these rules (Tjallingii 1993). This model of a system with input, internal processing, and output is adapted to a 3D image with in- and outgoing flows and detailed with environmental parameters, divided over several layers (derived from Tomásek 1979).

In this article, the resources featuring in the metabolism model are "knowledge" and "learning." This requires a qualitative rather than a quantitative model. The quality of the input flows, such as the preconditions, the facilities, the build-up, and operation of networks, determines social resilience. The depth of social learning during the process from input (social resilience) to output (physical resilience) determines the quality of the process, for example, how well the incoming flows are used to identify and develop solutions. The quality of design propositions, their resilience, and climate adaptive capacity, for example, the output, determines physical resilience.

2.1. *The input*

In preparing for a successful design charrette, several aspects are important:

(1) A good venue adds extra meaning when the location is linked to the problems discussed and invites participants to start discussions.
(2) The facilitator should not start designing. This allows participants to feel free to contribute. The charrette leader needs only to create the space to design, and keep the time.
(3) Input, working methods and outputs need to be visual. Representing climate change (Barker 2003) helps to conceptualize the problem, identify potential feedbacks, and communicate between disciplines. Mapping social capital, as suggested in the *Resource Generator* (Van Der Gaag & Snijders 2005), is in the majority of the cases not part of the process.
(4) Beneficial steps are an official welcome, the *30-30 exercise*,[2] sketching at regional/landscape and local scale, build *plasticine* models and final presentations.
(5) Involving primary school children is extremely fertile (Roggema, Jones, et al. 2012a). Children have extraordinary ideas, but they are also the people that actually will live in their own designs. Moreover, exchange of ideas between adults and children is very productive and opens constrained adult minds.

Several elements determine the success of harnessing local expertise as proven in recent charrettes conducted in Bendigo and Sea Lake, Victoria (Roggema, Jones, et al. 2011; Roggema, Martin, Horne 2011; Roggema et al. 2013; Clune et al. 2012):

(1) Announce the importance well in advance.
(2) Strategic key players, charismatic group-thinkers, and specific experts are critical to create a successful team.
(3) Safeguard support of local authorities and reconfirm this regularly.
(4) Organize a short and intense experience to guarantee interest in the results.
(5) Link outcomes to planning processes.
(6) The venue needs to combine serious workspace with space to "lean back."

One way to increase social resilience is to understand and use network theories. "Social networks hold the secret to the co-development of knowledge with stakeholders and citizens, in which reflexivity, transgression of institutional boundaries, extended peer review and a strong focus on the process is seen as more productive" (Salter et al. 2010). Self-organizing inter-organizational networks become autonomous and resist central guidance. They replace *government* by *governance*. Efficient governance relies on self-organizing networks (Rhodes 1996). This "community-based participation" (Lane & Mcdonald 2005; UNDP 2008) enhances climate adaptation (Van Aalst et al. 2008). Public inclusion in policy is a constructive combination of approaches with room for expert–led discussions and creative brainstorm sessions, well-deliberated started with clarifying the parameters for decision making. Inclusion of appropriate people and legitimacy of the inclusion process are essential to involve the public (Few et al. 2007). The challenge is not to create experience-based ways to engage the political and expert domains (Feldman & Khademian 2007) where people can make sense of global change (Bush et al. 2002). When impacts are demonstrated at local, familiar locations (Lindseth 2005), they are mobilized. Network management mediates inter-organizational policymaking (Klijn & Koppenjan 2000) and assumes actors to be mutually dependent and involved in games, for example, where a series of interactions occur (Crozier & Friedberg 1980; Rhodes 1981; Scharpf 1997). Network analyses can identify optimal locations where to improve adaptive capacity. Physical networks, such as the energy grid, the water system, transport or ecological systems, determine specific places (Roggema & Stremke 2012) where, in combination with the mapping of climate impacts, measures have the largest effect. Social aspects often focus on capacity building for random or already convinced people. Identifying people with access to social capital, as charted in the *Resource Generator* (Van Der Gaag & Snijders 2005), is not a specific objective yet. Access to essential resources is easier if connections are stronger, and resources are more prevalent, visible, or appropriate. People with access to key resources open ways to access other resources. Linking the Resource Generator with climate adaptation could create a geographic tool showing where the strongest relations and easiest access to social capital resources exist. Combining the outcomes with climatic hazards services leads to a view of the adaptive capacity of the community (e.g., best access × most needed climate services). This provides insights about preferred locations of housing, social amenities, industries, or infrastructure.

2.2. *The design charrette*

When (eco-) systems are managed for stability, they tend to end in turbulent change (Peterson et al. 2003). The same can be expected of governance systems. The scientist becomes one of several actors in the knowledge generating process, together with local groups (Kates et al. 2001). A crisis triggers learning and creates space for new management trajectories (Westley 1995), allowing industries to increase resilience, survive turbulent times, and reorganize (Hamel & Välikangas 2003).

Social learning contributes to the ability of local communities to self-organize and increase resilience hence deal with sudden change. To increase resilience, framed as a goal to pursue through adaptive co-management, mindsets and status quos must be challenged through a systemic, whole-systems perspective with experimentation. Hence, it necessarily is local (Wilkinson 2012), where the necessity is long recognized to coexist with gradual or rapid change (Folke et al. 2005) through developing robust adaptation strategies that take advantage of change and turn them into opportunities for development (Carpenter & Gunderson 2001). They may evoke, survive, or follow change (Berkes & Folke 1992). Socioecological dynamics during periods of rapid change requires adaptive learning (Batterburry 2010) through several temporal and spatial scales: (1) learn to live with change and uncertainty, (2) combine types of knowledge and learning, (3) create self-organization toward resilience, and (4) nurture resources of resilience for renewal (Folke et al. 2003). Adaptive governance (Swanson & Bhadwal 2009) connects individuals and institutions at multiple levels during abrupt change. They self-organize and emerge into flexible community-based systems, tailored to specific places and situations, inclusive of different organizations and levels. This flexibility allows learning and responses to change (Ruitenbeek & Cartier 2001; Olsson et al. 2004). In this dynamic self-organizing process of learning by doing, with its learning paradoxes (Armitage et al. 2008), institutional arrangements and knowledge are tested and revised (Folke et al. 2002). Socioecological systems view crisis as an opportunity to transform to a more desired state (Folke et al. 2005). During transformations, meaningful new "order" and actions upon it are invented and reinvented (Westley et al. 2002). This is considered a social process (Lee 1993; Wildemeersch et al. 1998; Clark et al. 2001), for which trust building is a prerequisite (Hahn et al. 2006) and expertise and skills of "ordinary" people are extremely useful (CfES 2011). Scenarios provide a platform for social learning and are seen as crucial to face uncertain, complex and conflict-laden problems. Participatory scenario workshops build and strengthen relationships, enhance participants to understand other perspectives and trigger systemic thinking (Johnson et al. 2012) and for institutions and their leaders to enhance adaptive capacity and community resilience (Keys et al. 2014). To build collective resilience, communities must reduce risk and resource inequities, engage local people, create organizational linkages, boost and protect social support, and "plan for not having a plan," which requires flexibility, decision-making skills, and trusted sources of information that function in the face of unknowns (Norris et al. 2008).

Core conditions for effective self-organization are (Vos 2013)

(1) A strong sense of common identity, meaning or purpose. Individuals must be able to connect their own sense of meaning to this overall identity, either consciously or subconsciously.
(2) A governing rule how individual agents relate and interact. This "rule" gets "codified" or reinforced when it improves chances to achieve the purpose or maintain their identity.
(3) Free flow of information from availability to demand.

A local community needs the greatest "depth" (Homan 2001) of learning to deal with uncertainty and the highest climate impacts. This only happens when collective and individual learning is simultaneously used to tackle adaptive challenges, while moving multiple times through Kolb's cycle, for example, experiencing concrete experiences, reflection and observation, abstract conceptualization, and active experimentation (Kolb 1984). This third-level learning in the "Law of Requisite Variety" (Conant & Ross Ashby 1970), "Breaking the Frames" is distinguished from the first ("Framing") and second ("Reframing") level (Homan 2001).

In learning levels, learning objectives (information transfer, skills and competency building, and mental model shift and knowledge creation) are combined with delivery approaches (instructor/expert, learner or team, partnership or community centered) (Figure 2). The highest degree of complexity is collaborative learning, where knowledge is equally present in facilitators and learners. Knowledge is created in collaborative, self-organizing processes. Learning "breaks the frame": a diversity of multiple perspectives is shared to generate new sets of meaning to produce novel, effective behavior. To generate knowledge for wicked or adaptive problems, collaborative learning is indispensible. Collective learning and sense-making processes create new views and mental models, forming more effective theories of

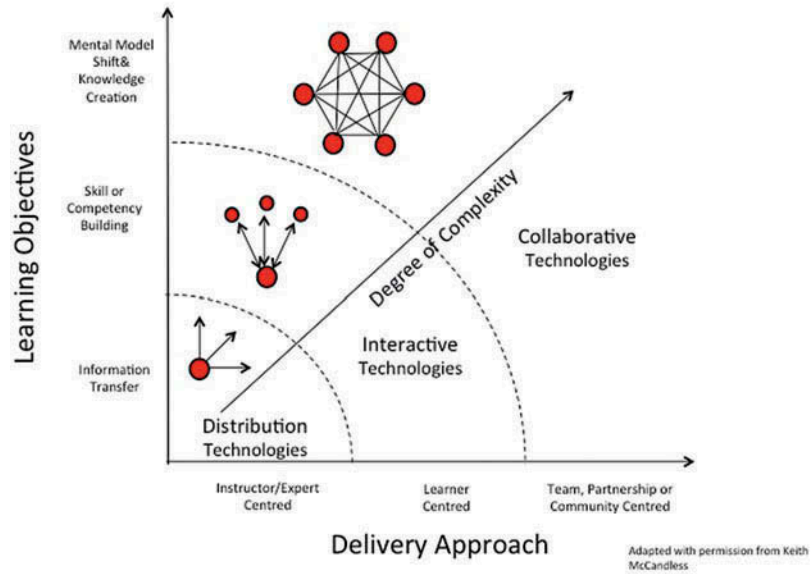

Figure 2. Three-level learning (Vos 2013).

action (Argyris & Schön 1974, 1978; Argyris 1992). Additionally, interventions in this collaborative learning realm are inherently cyclical and nonlinear using self-organizing processes to create continuously new responses to changing situations. These highly complex processes imply an adjusted relation between citizens and policymakers or scientists. Value creation takes place for society and citizen at the same time (paraphrasing Staub 2012): a process of co-creation through every phase of development and realization (Sanders 2006). From initiative (creating), design (making), realization (adapting) to use (doing). Respond to climate change requires technological and implementation breakthroughs in an open distributed innovation strategy (Milford et al. 2008). Open source approaches are the way forward, emphasizing interactive contributions of unexpected outsiders and ordinary citizens, loosened from established institutions. Climate adaptation is similar to organizational learning in the weakness for and ambiguity to urgent signals for change and uncertainty about benefits flowing from implementing measures (Berkhout et al. 2006).

2.2.1. *Design charrettes*

Climate adaptation is a social learning process, locally based and operating across multiple scales, actors, and institutions. Design, dealing with wicked problems (De Jonge 2009), is underrepresented. Design is a process of creating options, rejecting parts, reconstructing and shaping, fit to tackle wicked problems with no single, definite answer (Rittel & Webber 1973). Using design in collaborative processes is therefore extremely helpful, allowing participants to contribute and examine problems from various perspectives. Design charrettes (Lennertz & Lutzenhiser 2006; Lindsey et al. 2009) deal in a practical way with wicked problems and rapid change (Mandell & Steelman 2003):

Design charrettes are intensive design-based ways to empower local expertise. In the process, community members and local experts are mixed with academics, designers, and policymakers. This group designs and models a desired, but unforeseeable future. The impact is twofold: collaboration and exchange leads to changed social constellations and design propositions imply spatial transformations. Condon (2008) defines nine general rules for a good process. The most significant are

(1) Design with everyone. Charrettes are integrative and contain a variety of possible solutions. This is intuitive and judging, which makes it accessible for many. Everyone is a designer.
(2) Start with a blank sheet. Standing around the draw-board with a large map of the site, a simple action to overlay a blank piece of transparent paper will invite and challenge all. Everyone is invited to draw the future on the blank paper.
(3) Provide just enough information. Too much information causes decision paralysis, but too little leads to bad proposals. "Just enough" is determined through expertise of the participants in the form of concise and accessible maps and schemes.
(4) Drawing is a contract. Drawings produced embody consensus as experienced and achieved by all. They form a well-understood agreement in images. The drawings cannot be broken without consent of the group and function as a very strong commitment.

If the design charrette is organized as a social learning process, a variety of people feel free to participate and bring expertise, experience, and knowledge.

2.3. *The output*

The outputs of the design process are resilient and adaptive designs. This manifests itself through design proposals as physical propositions enhancing climate adaptation.

Resilience thinking (Holling 2001; Walker & Salt 2006) about the city (Newman et al. 2009) focuses mainly on mechanics of the city. It emphasizes analyses, understanding of the system, and operational improvements, but hardly impacts city design. Resilience is "the capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks" (Walker et al. 2004; Walker & Salt 2006). It includes the ability to learn from disturbance[3] and is seen as a socioecological systems property, allowing the system to bounce back and recover from external shocks. Adaptability is the capacity of actors to manage resilience (Walker et al. 2004). It collectively determines whether crossing into an undesirable system regime can successfully be avoided. Especially in times of crisis resilience building through stakeholders describing the system and its major uncertainties in future dynamics (Walker et al. 2002) is essential. Under pressing conditions, increasing resilience understanding of knowledge generation for rapid change and required social resources and strategies to deal with true uncertainty must be improved (Costanza & Cornwell 1992; Kates & Clark 1996). Dealing with natural disturbances when planning socioecological, adaptive, systems, the "defeat disorder," assuming change and explaining stability, challenge emerges (Gleeson 2008). Dealing with uncertainty this must be replaced by the science of surprise (Wilkinson 2012), assuming stability and explaining change (Van Der Leeuw 2000).

A resilient, adaptive city is capable of constantly changing shape under the influence of external shocks, while relocating urban components when necessary (Roggema 2013b). Viewing the city as a swarm (Roggema 2012a) diversity and modularity of city patterns must be enhanced, contain (tight) feedbacks (Walker & Salt 2006; cited in Pisano 2012), and be redundant (Ostrom 1999). *Redundancy* provides the city free space to fit new functions, *diversity* enhances differences of urban objects to create a larger *modularity*, enhancing the mobility of urban objects. Tight *feedbacks* allow urban objects to mutually react and develop self-organization. These properties guide resilience building in city design.

Resilient communities are more adaptive. Climate adaptation is "an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC 2007) and is deemed necessary since the inert character of GHG-emissions (IPCC 2001). Moderate climate change is replaced by extreme, surprising weather events (Steffen et al. 2013). Moreover, change is nonlinear, showing graphs in staircases, not in hockey sticks (Jones 2010, 2011). This new risk landscape (Kahn & Wiener 1967) demands to increase resilience. Flexibility in planning as explored in Swarm Planning (Roggema & Van Den Dobbelsteen 2008; Roggema 2012a, 2012b, 2012c) emphasizes the shift to an organic paradigm (Brouwer 2011; Broess 2012) in which dynamic open-ended solutions are beneficial.

Climate adaptation is framed in between bottom-up and top-down approaches, referring to social (focus on past and present) and physical (focus on the future) vulnerability (Dessai & Hulme 2004). Communities ("human, or social systems") are seen as a crucial factor in these definitions, but in practice their role is weak as their involvement in developing climate policies, contributing to research or defining their own climate-proof future, is limited (Roggema 2013a). Climate change has long been thought a scientific problem to be solved in a laboratory, but the survival of the human race depends as much on co-evolution and the power to collaborate (Flannery 2011). Record-breaking weather across Australia (Steffen et al. 2013) intensifies the need for innovative adaptation strategies in land-use planning, adapting both built structures and ourselves (Pijnappels & Dietl 2013). Community action is key to adaptation (CfES 2012). Citizens are scientists. In addition to economic and population decline, country towns face pressures from climate extremes. This makes the community itself the greatest asset and source of potential success in climate adaptation (Beer et al. 2012). Adaptation is not always tangible, or it may be hidden in measures taken in other sectors (Pijnappels & Dietl 2013). Therefore, approaches and methods delivering tangible results and involve the community, such as via design charrettes, must be stimulated. The involvement of communities depends on the framing of climate adaptation. Frames are "interpretive storylines that set a specific train of thought in motion, communicating why an issue might be a problem, who or what might be responsible for it, and what should be done about it" (Nisbet 2009). Climate adaptation fits in the social progress frame, which aims at improving quality of life, seeking harmony with nature instead of mastering it (Nisbet 2009). If we connect this to decision making in uncertainty about possible outcomes (Thompson 2003), inspirational strategies, characterized by "rich picture" drawing and learning-scenarios (De Boer et al. 2010), are most beneficial.

Adaptation is a continuous learning process and institutional change responding to new knowledge and changing circumstances, contrasting adaptation as result of technical measures (Fünfgeld 2012). This gradual process requires iterative, transformational change of systems, institutions, and communities to meet yet unknown solutions. Adaptation depends on people (Fünfgeld 2012). Solutions are collaboratively determined using a variety of information from different perspectives following the characteristics of adaptive governance (Swanson & Bhadwal 2009). Social adaptation (Horstmann 2008; Fünfgeld & Mcevoy 2011) occurs at three nested levels: the meta-level of values and beliefs, the conceptual, theoretical level, and the operational level of implementation and decision making. In practice, however, it is framed as institutional and not from a citizen's perspective. Co-design, co-development, co-decision making, or co-learning is seldom and the "valve" of climate change (Roggema 2012b) remains closed. This valve is only opened when adaptation anticipates change as a social progress problem and connects with the inspirational strategy (De Boer et al. 2010). Hence, the community is truly involved and the citizen is seen as a scientist.

3. Case studies

The proposed framework has been used and further improved in two Australian case study areas.

The City of Greater Bendigo is located approximately 200 km northwest of Melbourne in a bushfire-prone area. Besides fire hazards, the city is under pressure of heat waves and, occasionally, local flooding. These climate impacts cause problems already, but these are expected to increase in the future. Simultaneously, Bendigo is very popular as a regional residential city because of the distance to Melbourne and its beautiful natural environment. The fact the surroundings consist mostly of forest makes it an extra attractive place to live, but it also increases the risk and vulnerability because more people are exposed to amplified risks. The popularity of the city for new residents demands a future vision how and where new residential areas must be planned. Climate change is seen as an important factor determining the choices to be made. The city has an active population in the form of environmental groups, collaborations of companies, public–private alliances, and youth involvement. This formed a strong basis for developing and organizing a series of two design charrettes in Bendigo.

The second case study has been executed in the small town of Sea Lake, located approximately 400 km north of Melbourne, in the middle of the grain belt of Victoria. The town has to deal with extreme heat in summer, which often leads to extended droughts and occasionally fires. The main problem for a successful harvest is the timing of rainfall, which occurs every year around the same period. The planning of farmers is tuned according to these expectations. Climate change however has changed the precipitation patterns posing new problems for the farmers in the region. At the same time, the pressure on the community is growing as a result of population decrease. Despite this, the involvement of local people in planning processes is high. In Sea Lake, local initiative is concentrated around the Advance Sea Lake Group Inc., which brings people together and coordinates local planning and economic development processes. This group co-organized the design charrette and provided the key participants.

In both case studies, the proposed metabolism framework has been used to identify the preparation as input, the design charrette as the processing mechanism and the design results as the output. In order to create the best possible metabolism according to the objectives of social and physical resilience, the input must be as sophisticated as possible, the processing must be intensive, and the output must be qualitatively as high as possible.

In the two case studies, social resilience is increased in the preparation phase. Before the charrette, a bond is created between participants, the practical process facilitation is undertaken, and networking is stimulated. The potential participants are invited in advance and in a personal manner. The invited people represent a broad range of backgrounds, from academics, students, and local stakeholders to citizens, local experts, and government employees. It is important for two reasons. First, the diversity brings the best possible expertise to the table, and secondly, the mix of people stimulates exchange and network building among participants, who formerly did not know each other.

During the process of the design charrette, the prearranged conditions are used as the basis for learning. Existing scientific knowledge and the social constructs are transformed during the charrette in new knowledge and solutions. Learning occurs as a result of interaction and working on scientific as well as local expertise. A sequence of exercises enhances learning. Different techniques, such as creative brainstorming, designing and sketching, and building models, provide the environment in which this is encouraged.

As a result of the design charrettes, two effects became visible. First, the content of design propositions represented improved physical resilience in the case study areas. This is mainly expressed in the way spatial proposals create space for responding to and anticipating climate impacts, such as bushfires, heat, or floods. Secondly, during the charrettes the social learning process itself has led to new connections and collaborations, which enhance capacity building and increase social resilience.

3.1. *Input*

The input side of the framework consists mainly of the preparation of the design charrette. These preparations aim to unite the participants and gather the right information. Moreover, the facilitation and program development contribute to the social interconnectedness and preconditioned social resilience. The preparations were supported through a design brief (Roggema, Jones, et al. 2011;

Roggema, Martin, et al. 2012), in which the basic information about the design process, practical information, and collected knowledge was brought together. The information in the design briefs was gathered through collaborations between local participants and experts, and modified scientific knowledge. The modification into visual, readable charts and maps was necessary to create a common language and to make information, which is sometimes difficult to read, understandable. In advance of the design brief, several groups of people were formed, who discussed specific parts of the design charrette input, such as climate change information, current spatial policies, the program and participants, and several others. This prephase already increased the commitment of participants and made them feel responsible for the quality of the results. It also led to the development of social constructs that were absent before and original innovative program elements that were unique. Through the involvement of many different groups of people in preparation for the charrette, the access to social capital was eased in a natural way. Through the talks with people involved, and via-via connections, the key players in the local community were easily identified. Because the groups preparing the charrette were different, a wide range of opinions about potential key players were given and, coincidentally or not, many times the same names came to the fore. This secured the best potential mix of participants, not missing any key player and direct and indirect access to the available social capital. Finally, identification of the facilitator was a specific task, which demanded rigorous deliberation. Often a designer is seen as the natural facilitator of a design charrette, but as a general rule the designers should be taken out of the design charrette lead. Even if the facilitator is a professional designer, he or she needs to withdraw his/her design influence in order to allow the participants to design for themselves.

As a result of the preparation phase, the design charrettes in Sea Lake and Bendigo committed the right people, the location and venue was related to the design problem, and the concise program was organized in clear steps (Roggema et al. 2013). Even without using the *Resource Generator,* the best possible participants were selected and network building took place before and during the design charrette. Especially in Sea Lake the preparation took place in collaboration with the Advance Sea Lake Inc. group, which consisted of core people with access to social capital in the community. This happened in Bendigo as well, through government representatives molding the ideal participants, for example, the people with access to social capital.

3.2. *Design charrettes*

The design process during the charrette aimed to encourage (social) learning with the purpose of creating a shared vision for the future of the case study area. This process differs for every charrette and depends on the people, the problem, and the policy. However, there are several steps in the design charrette that stimulate learning more than others. Besides the more traditional welcoming speeches and closing presentations, the exercises in between form the real platform for learning, collaboration, and exchange. Three types of exercises have been proven to drive social learning. The "30–30"exercise, as described before, allows participants to define their community by looking back 30 years on four themes and look ahead 30 years. In groups, people follow former group work by adding ideas, memories, and concepts that together build up their community, both as remembrance and as a projective phantasy. The second type is sketching and drawing in a different group on different scales. The fact that groups are subsequently mixed and work on different scales ensures cross-exchange between participants with different backgrounds, bringing different perspectives, especially when changing scales of designing. The third way of collaborative design is the plasticine modeling. This is a tactile way of solidifying ideas. During the modeling, people mainly use their creative brain-half instead of their rational one. This opens minds and allows people to add on to others ideas. Because people work with their hands, they talk and build simultaneously and the vision, already underpinned and explored through the former drawing, emerges in 3D. These three exercise types all stimulate exchange of ideas and social learning among participants, not the least due to a challenging time-plan and a relaxed atmosphere.

As result of these design charrette processes, we found that (social) learning is enhanced in the following ways:

(1) New social constructs were developed (Figure 3). Everyone participant built new networks. Exchange between participants of different backgrounds, interests, and age emerged.
(2) Drawings and models were unifying elements because everyone contributed and a strong

Figure 3. Learning in action during the Bendigo charrette.

ownership of both visuals and, more importantly, the content visualized was vested.

(3) A very interesting mix of people with access to social capital and resources attended the charrettes. A shared problem perception emerged and was taken as the focus for the entire charrette.

(4) The tactile methodology, using drawings and plasticine models, added to the depth of learning. Participants experienced multiple visioning approaches, not only in talking or writing, but also through sketching and building.

(5) Learning and re-learning occurred in a cyclic process. Kolb's cycle (Kolb 1984) shaped the charrettes. While sketching abstract conceptualization happened while reflection and observation occurred during intermediate discussions and final presentations. Concrete experiences and active experimentation took place during the 3D-plasticine modeling.

3.3. *Output*

The proposed framework defines as the output aspects of physical resilience. In contrast with the current thinking about urban metabolism, the output in our cases does not have the objective to be reduced (e.g., less waste, less outgoing flows of water, energy and waste), but aims to increase amounts, in our case an increase of the physical resilience in the case study areas.

The question to be answered is whether the design process has contributed to the development of increased resilience and adaptive quality of the design propositions. In the design propositions, resilience and adaptation are seen as concrete subjects, which are used to create spatial modifications and adjustments in the landscape. This implies that, other than usual abstract goal setting and complex definition debate, these concepts are translated into propositions for changed land use and made explicit in spatial interventions. In the two case studies, the focus lies on climate adaptation and therefore the spatial proposals all include adaptation measures, but nevertheless, other topics, such as traffic solutions, social innovations, and education and tourism, were also integrated in the designs. The involvement of local experts and participants in the design charrettes initiated this broadening of the solutions.

The design charrettes have delivered designs that visually represent a resilient and climate adaptive future for the local community in a broad sense. This can be illustrated through the design proposals themselves. As an example, one of the design propositions developed during the design charrette in Bendigo (Figure 4), dubbed "the Scarcer the Water …..", enhances physical *resilience* through (Roggema, Jones, et al. 2011):

(1) Increase the productivity both economically and in agriculture of the landscape in and around Bendigo, improve the liveability of the residential and industrial neighborhoods in Bendigo, for instance, through increased preparation for and safety of built structures for potential impacts of bushfires and increase sustainability, both through improving the environmental quality (water, air, and soil quality, and the clean supply of energy, food, and water) and through behavioral change and sustainable lifestyles of citizens.

(2) Stimulate the engagement of the local community in contributing ideas and projects that improve the resilience of the area, for instance, through local involvement and leadership to be taken up by residents for projects in the field of fire-protection, water-saving, and ecological improvements. This way of engaging local residents leads then to an improved feel of responsibility for the quality of the environment and development of a sustainable future.

(3) In the design proposition droughts, heavy rainfall and preventing floods are anticipated through the capturing and efficient use of available water in urban and residential neighborhoods, as proposed in the Water Sensitive Urban Design program (Wong & Brown 2009), and through enhancing the capacity of natural waterways to store water, increasing the ecological values, and extending the functionality of waterways as a sponge.

(4) Dealing with heat stress, for instance, through creating refuges in cooled buildings and preventing energy blackouts both imply an increase in renewable energy supply. The design proposition emphasizes this through introducing solar energy plants in the surrounding landscape of Bendigo. This not only mitigates future problems, it also starts a process of economic growth and improves environmental health.

(5) Introduce the use of visible icons for resilience, such as the Bendigo clock tower, which is proposed to be operating as a water meter.

(6) To tackle food scarcity, which is expected to become more important in the (near) future, the design proposal emphasizes to encourage self-sufficient agriculture and, as an example, create market gardens in residential neighborhoods.

(7) To become more flexible en less dependent on car use it is proposed to increase the infrastructure specifically meant for public transport and to create commuting bike paths.

In another example, "Salt, Sky, Sun and Stars" (Figure 5), one of the design proposals developed during the design charrette in Sea Lake, proposes to increase the *resilience* through (Roggema, Jones, et al. 2012b):

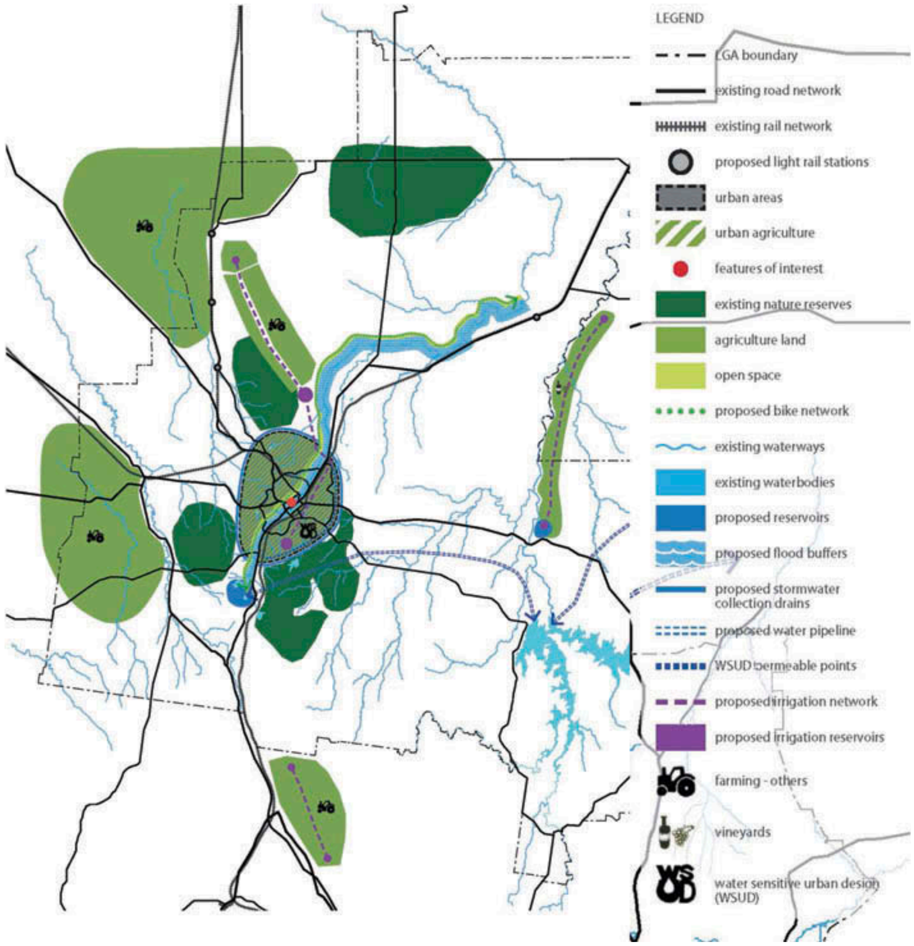

Figure 4. The Scarcer the Water (Roggema, Jones, et al. 2011).

(1) The development of the tourism potential of the town. The design proposition proposes the creation of an arts district in town, where a museum, an outside movie theater projecting on the walls of the old silos and art in galleries, is located. This enhances the recreational potentials, which are also underpinned by the proposal to develop an eco-lodge at the edge of the lake, where the tranquility of the lake can be experienced in combination with stargazing the amazing night skies.

(2) In order to anticipate uncertainties of future climate impacts, it is proposed to diversify grain farming in the area. Not only new techniques, such as drop-irrigation and full automated harvesting, increase the resilience of grain production for unexpected or long-lasting droughts, additional farming categories, such as pigs, kangaroos, chooks, and emu, are also part of the picture.

(3) The basis for education is already strong, but requires constant improvements to stay competitive. Therefore, innovative knowledge development, linked to the local assets, such as astronomy, salt, water, and energy-harvesting and -farming techniques and management, is suggested to extend the existing secondary college and to attract students from other parts of Australia and abroad.

(4) The development of a local, ecological community garden, where native vegetation, the storage and collection of rainwater and local harvesting of renewable energy comes together. This garden is also representing the community feel, where activities and voluntary contributions of residents can come together.

(5) The harvesting and collection of rainwater in the community garden must be accompanied by a broader program, encouraging residents to take storage and efficiency measures in and around their houses and a program focusing on public spaces where water can be captured, such as natural waterways and creaks, and around industrial estates.

(6) In the design proposition, the harvesting of renewable energy, particularly through solar energy, is located in solar plants near the town and, in combination with a wind farm, at the edge of the lake. The

Figure 5. Salt, Sky, Sun and Stars (Roggema, Jones, et al. 2012b).

collected surpluses of energy can be stored in the available salt of the lake. This requires a new technique, which is currently under development and could be further sophisticated in knowledge programs undertaken through the secondary college.

(7) In the town itself, the quality of infrastructure must be improved, both in the quality of infrastructure (material use, realization of attractive, greened roads, but also in the application of place-making and way-finding improvements). Besides the internal improvements, the connections with other towns and the wider networks, through bus and taxi services with surrounding facilities (such as the airport in Swan Hill) and increased accessibility of the World Wide Web, must also be enhanced.

The output of these design charrette processes delivers design propositions, enhancing the physical resilience of landscapes and towns for potential climate impacts through spatial interventions and adjustments in the environment. However, this, preliminary expected, result is accompanied by an increase in social resilience too. The networks and collaborations that emerged during the design charrettes have been extended into business collaborations and public–private conjunctions in concrete planning projects resulting from the design charrettes. Moreover, the mutual community conversation in both towns has led to increased awareness about potential climate impacts and the need to work together and make sure the exchange of information and ideas continues.

In comparison with other planning processes, a distinction has to be made between other charrettes or similar design processes and "regular" planning processes. In academic literature, design charrettes are only marginally represented (Sutton & Kemp 2006; Anderson et al. 2010) and are predominantly discussed in a practical sense (Lennertz & Lutzenhiser 2006; Condon 2008), except for the theoretical-practical approach in the book *Design Charrettes: Ways to Envision Sustainable Futures* (Roggema 2013b).

However, reports are published about the results single-design charrettes have delivered. Many of these charrettes have chosen a different theme as main topic than climate adaptation, such as energy and spatial planning (Van Dam & Noorman 2005; Provincie Drenthe 2006a, 2006b; Roggema & Van Den Dobbelsteen 2006; Lab R+E+M 2008; Roggema et al. 2008; Roggema 2009b; Grontmij 2010; Polman 2010; Roggema & Boneschansker 2010; Sikkema & Lucius 2010; Van Den Berg 2010), GHG-emission reduction (Condon et al. 2009), nature and spatial design (DLG 2005, 2009; Waddenvereniging 2009, 2010), urban design or redevelopment of urban environments (University of British Columbia 2004; Opticon Design Inc. 2009; Broadland Land Group 2010; Scottish Sustainable Communities Initiative 2010), or, indeed, climate adaptation (Roggema 2009a).

Interesting enough, many of these concrete project reports describe not only the development of a sustainable, resilient or "better" design, which could be captured as physical resilience, but also the increase of network connections, collaborations between partners that before were ignorant and new found relationships, which points at the increase of social resilience as a result of these processes.

The differences with regular planning processes are more clear. Comparing the design charrette approach with the development of the regional plan in Groningen Province (Provincie Groningen 2009) and with the Metropolitan Planning Strategy "Plan Melbourne" (The State of Victoria, Department of Transport, Planning & Local Infrastructure 2013), both these planning processes can be characterized as an interaction by sending and receiving. In several, very intensive steps, the leading body sends out information, such as intended proposals, for which they ask citizens to give their opinions and responses. This encapsulates the thoughts of the most active citizens on the content of the proposals, which then subsequently are improved by the governing body. However, it may be stated that this way of "participation" of citizens in the planning process may lead to an increase in the physical resilience of the planned proposals (although even so this may not be the case), it merely does not enhance social resilience, because citizens are framed outside the conception of design proposals and only asked to reflect. The design charrette approach does exactly this: it allows citizens to actively conceive spatial proposals for an enhanced future resilience of their community and environment and while actively participating in debate about the design, social learning occurs, which gives the basis for an increase in social resilience.

Reflecting on the proposed framework for planning processes, a grounded approach for creating a "metabolism" that is beneficial for increasing both social and physical resilience is absent in many design charrette, or alike, processes, and also not in use in regular planning processes. Therefore, to harvest and improve the resilience in communities, the framework is an excellent tool that requires thorough and rigorous applications in practical design trajectories and academic reflection on these processes.

4. Discussion and conclusions

The proposed theoretical framework we have presented in this article is novel. This brings new questions with it. The coupling of social and physical resilience may be innovative, but it is not yet extensively researched. The conceptual linkage is grounded in practical experiences, but not yet theoretically underpinned. The theoretical framework of inputs to a system, processing of information and resources, leading to beneficial outputs is a positive framing and reuse of the metabolism model. However, this model has never been meant to serve in a participatory, social learning context. This deserves further elaboration. Also, the theoretical framework is not yet firmly grounded in social theory. This omission should and could be repaired through further strengthening of the framework with institutional economics, sociology, and political science, among other scientific fields. The social learning power of charrettes is well known, but scholarly underdeveloped. It is recommended to intensify action research programs in which empirical findings are brought to a level that generates a sound theoretical and academic understanding.

The theoretical framework we have presented in this article supports local communities to improve their preparedness for climate impacts. The used model is derived from urban metabolism. In our framework, the core element, for example, the place where input is processed to become output, is the design charrette. During the charrette, input resources that, for example, the selection of participants and the quality of preparations, are processed in the charrette environment and deliver outputs in the form of improved resilience and adaptation of design propositions. As demonstrated, the processing only takes place when deep learning is encouraged in the charrette.

In the framework, the objective is to provide the highest quality input, for example, the best possible conditions and involve the best social "capital." The output of the model needs to create the highest achievable resilience and adaptation. In terms of metabolism, these flows must be as large as possible that contrasts with the purposes in the original metabolism model, which aims to reduce incoming and outgoing flows.

When community resilience and adaptive capacity is sought for uncertain and unprecedented climate impacts, deep learning, including transformative processes, is required. This is necessary because of the new types of problems we face. The best results for dealing with wicked problems are achieved with community-based adaptive learning. The design charrette overcomes everyday barriers, such as "closing the ranks" behavior that occurs in many organizations, which stand in the way of reaching innovative and ground-breaking solutions.

The design charrette delivers tangible results in the form of adaptive spatial plans and visualized futures that are collaboratively developed using expertise and ideas of citizens in combination with an academic understanding of the problem. This approach is locally oriented, as local climate problems require local adaptation and the ideas and contributions of local citizens.

Notes

1. A design charrette is defines as "a collaborative design and planning workshop that occurs over four to seven consecutive days, is held on-site and includes all affected stakeholders at critical decision-making points" (Lennertz & Lutzenhiser 2006).
2. The 30-30 exercise is asking participants to look back 30 years in history and describe how technology, social aspects, technology, and climate appeared, describe the present situation, and imagine how these themes would turn out 30 years in the future.
3. http://www.resalliance.org

References

Adger WN, Agrawala S, Mirza M. 2007. Assessment of adaptation practices, options, constraints and capacity. Chapter 17. In Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE, editors. IPCC, 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge (UK): Cambridge University Press.

Allmendinger P. 2002. Towards a post-positivist typology of planning theory. Plann Theor. 1:77–99. doi:10.1177/147309520200100105

Anderies JM, Janssen MA, Ostrom E. 2004. A framework to analyze the robustness of social-ecological systems from an institutional perspective. Ecol Soc. 9:18. Available from: http://www.ecologyandsociety.org/vol9/iss1/art18/

Anderson A, Fiebe J, Johnson E, Sabia T, Mills J. 2010. Optimism and a thousand charrettes. Natl Civ Rev. 99:7–10. doi:10.1002/ncr.20023

Argyris C. 1992. On organisational learning. Cambridge (UK): Blackwell Publishers.

Argyris C, Schön D. 1974. Theory in practice. San Francisco (CA): Jossey-Bass.

Argyris C, Schön D. 1978. Organisational learning. Reading (MA): Addison-Wesley.

Armitage D, Marschke M, Plummer R. 2008. Adaptive co-management and the paradox of learning. Global Environ Change. 18:86–98. doi:10.1016/j.gloenvcha.2007.07.002

Barker T. 2003. Representing global climate change, adaptation and mitigation. Global Environ Change. 13:1–6. doi:10.1016/S0959-3780(02)00085-7

Batterburry S. 2010. Adaptive learning – a think-tank on preparedness for climate change adaptation in local and state planning in Victoria. Melbourne: VCCCAR and University of Melbourne.

Beer A, Tually S, Kroehn M, Martin J, Gerritsen R, Taylor M, Graymore M, Law J. 2012. Australia's country towns 2050: what will a climate adapted settlement pattern look like? Final report for the national climate change adaptation research facility. Queensland: Griffith University.

Beierle TC, Konisky DM. 2000. Values, conflict, and trust in participatory environmental planning. J Pol Anal Manag. 19:587–602. doi:10.1002/1520-6688(200023)19:4<587::AID-PAM4>3.0.CO;2-Q

Berkes F, Colding J, Folke C, editors. 2003. Navigating social-ecological systems: building resilience for complexity and change. Cambridge (UK): Cambridge University Press.

Berkes F, Folke C. 1992. A systems perspective on the interrelations between natural, human-made and cultural capital. Ecol Econ. 5:1–8. doi:10.1016/0921-8009(92)90017-M

Berkes F, Folke C, Colding J, editors. 2000. Linking social and ecological systems: management practices and social mechanisms for building resilience. Cambridge (UK): Cambridge University Press.

Berkhout F, Hertin J, Gann DM. 2006. Learning to adapt: organisational adaptation to climate change impacts. Clim Change. 78:135–156. doi:10.1007/s10584-006-9089-3

Brandizio ES, Ostrum E, Young OR. 2012. Connectivity and the governance of multilevel socio-ecological systems: the role of social capital. In: Bernard Christophe B, Pérez R, editors. Agro-ressources et ecosystemes: enjeux societaux et pratiques manageriales. Villeneuve d'Ascq: Presses Universitaires du Septentrion; p. 33–69.

Broadland Land Group. 2010. The Belmore Park Charrette [Internet]. Norwich: Broadland Land Group; [cited 2011 Sep 26]. Available from: http://belmorepark.info/docs/Broadland%20park%20precharrette_download.pdf

Broess H. 2012. Onbedekt Bloeiend. Lezing Opening Krimpatelier. Groningen: Academie van Bouwkunst.

Brooks N, Adger WN, Kelly PM. 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. Global Environ Change-Human Policy Dimens. 15:151–163. doi:10.1016/j.gloenvcha.2004.12.006

Brouwer J. 2011. De Eindeloze Trap. Doetinchem/Enschede: AfdH Uitgevers.

Bush J, Moffatt S, Dunn CE. 2002. Contextualisation of local and global environmental issues in north east England: implications for debates on globalisation and the 'risk society'. Local Environ. 7:119–133. doi:10.1080/13549830220136436

Carpenter SR, Gunderson LH. 2001. Coping with collapse: ecological and social dynamics in ecosystem management.

BioScience. 51:451–457. doi:10.1641/0006-3568(2001)051[0451:CWCEAS]2.0.CO;2
Clark W, Jäger J. Van Eijndhoven J, Dickson N. 2001. Learning to manage global environmental risks: a comparative history of social responses to climate change, ozone depletion and acid rain. Cambridge (MA): MIT Press.
Cleaver F. 1999. Paradoxes of participation: questioning participatory approaches to development. J Int Dev. 11:597–612. doi:10.1002/(SICI)1099-1328(199906)11:4<597::AID-JID610>3.0.CO;2-Q
Clune S, Roggema R, Horne R, Hunter S, Jones R, Martin J, Werner J. 2012. Design-led decision support for regional climate adaptation, final report, Draft 1.0. Melbourne: VCCCAR and RMIT University.
[CfES] Commissioner for Environmental Sustainability. 2011. Many publics, participation, inventiveness and change. Melbourne: Commissioner for Environmental Sustainability, The State of Victoria.
[CfES] Commissioner for Environmental Sustainability. 2012. Climate change Victoria: the science, our people and our state of play. Foundation paper one. Melbourne: Commissioner for Environmental Sustainability, The State of Victoria.
Conant RC, Ross Ashby RW. 1970. Every good regulator of a system must be a model of that system. Int J Syst Sci. 1:89–97. doi:10.1080/00207727008920220
Condon P, Owen SM, Miller N. 2009. Sustainability by design, City of North Vancouver, 100 year sustainability vision [Internet]. Vancouver: City of North Vancouver; [cited 2011 Sep 26]. Available from: http://www.cnv.org/c/data/3/541/100%20Year%20Sustainability%20Vision.pdf
Condon PM. 2008. Design Charrettes for sustainable communities. Washington (DC): Island Press.
Costanza R, Cornwell L. 1992. The 4P-approach to dealing with scientific uncertainty. Environ Sci Policy Sustainable Dev. 34:12–42, 42. doi:10.1080/00139157.1992.9930930
Crozier M, Friedberg E. 1980. Actors and systems: the politics of collective action. Chicago (IL): University of Chicago Press.
Davy B. 2008. Plan it without a condom! Plann Theor. 7:301–317. doi:10.1177/1473095208096885
De Boer J, Wardekker A, Van Der Sluijs JP. 2010. Frame-based guide to situated decision-making on climate change. Global Environ Change. 20:502–510. doi:10.1016/j.gloenvcha.2010.03.003
De Jonge JM 2009. Landscape Architecture between politics and science, an integrative perspective on landscape planning and design in the network society [PhD thesis]. Wageningen University. Wageningen: Uitgeverij Blauwdruk/Techne Press
De Vriend HJ, Van Koningsveld M. 2012. Building with nature: thinking, acting and interacting differently. Dordrecht: EcoShape, Building with Nature.
Dessai S, Hulme M. 2004. Does climate adaptation policy need probabilities? Clim Pol. 4:107–128. doi:10.1080/14693062.2004.9685515
Dessai S, Hulme M. 2007. Assessing the robustness of adaptation decisions to climate change uncertainties: a case study on water resources management in the east of England. Global Environ Change. 17:59–72. doi:10.1016/j.gloenvcha.2006.11.005
Dessai S, Van Der SJ. 2007. Uncertainty and climate change adaptation – a scoping study. Utrecht: Copernicus Institute.
DLG. 2005. Presentatie schetsschuit haarveld. Haarzuilens: DLG.
DLG. 2009. Schetsschuit Middengebied Eindhoven-Helmond. Naar een Robuuste Groenblauwe Infrastructuur. Tilburg: DLG.
Feldman MS, Khademian AM. 2007. The role of the public manager in inclusion: creating communities of participation. Governance. 20:305–324. doi:10.1111/j.1468-0491.2007.00358.x
Few R, Brown K, Tompkins EL. 2007. Public participation and climate change adaptation: avoiding the illusion of inclusion. Clim Pol. 7:46–59. doi:10.1080/14693062.2007.9685637
Flannery T. 2011. Here on earth, an argument for hope. Melbourne: Text Publishing Company.
Folke C. 2006. Resilience: the emergence of a perspective for social–ecological systems analyses. Global Environ Change. 16:253–267. doi:10.1016/j.gloenvcha.2006.04.002
Folke C, Carpenter SR, Elmquist T, Gunderson LH, Holling CS, Walker BH. 2002. Resilience and sustainable development: building adaptive capacity in a world of transformations. Ambio. 31:437–440.
Folke C, Colding J, Berkes F. 2003. Synthesis: building resilience and adaptive capacity in social-ecological systems. In: Berkes F, Colding J, Folke C, editors. Navigating social-ecological systems: building resilience for complexity and change. Cambridge (UK): Cambridge University Press; p. 352–387.
Folke C, Hahn T, Olsson P, Norberg J. 2005. Adaptive governance of social-ecological systems. Annu Rev Environ Resour. 30:441–473. doi:10.1146/annurev.energy.30.050504.144511
Forester J. 1999. The deliberative practitioner: encouraging participatory planning processes. Cambridge (MA): The MIT Press.
Fünfgeld H. 2012. Local climate change adaptation planning. A guide for government policy and decision makers in Victoria. Melbourne: VCCCAR and RMIT University.
Fünfgeld H, Mcevoy D. 2011. Framing climate change adaptation in policy and practice. Melbourne: VCCCAR and RMIT University.
Gleeson B. 2008. Critical commentary. Waking from the dream: an Australian perspective on urban resilience. Urban Stud. 45:2653–2668. doi:10.1177/0042098008098198
Grontmij. 2010. K2: Klimaat en Krimp in Rurale Gebieden in Noord Nederland, Ontwerpatelier Grounds for Change. Assen: Provincies Friesland, Groningen en Drenthe.
Gunder M. 2011. Fake it until you make it, and then… Plann Theor. 10:201–212. doi:10.1177/1473095210387542
Habermas J. 1987. The theory of communicative action. Vol. 2. Cambridge (UK): Polity Press.
Habermas J. 1993. Justification and application: remarks on discourse ethics. Cambridge (UK): Polity Press.
Hahn T, Olsson P, Folke C, Johansson K. 2006. Trust-building, knowledge generation and organizational innovations: the role of a bridging organization for adaptive co-management of a wetland landscape around Kristianstad, Sweden. Hum Ecol. 34:573–592. doi:10.1007/s10745-006-9035-z
Hamel G, Välikangas L. 2003. The quest for resilience. Harv Bus Rev. 81:52–63.
Healey P. 1997. Collaborative planning: shaping places in fragmented societies. London: Palgrave.
Hillier J. 2003. Agonizing over consensus: why Habermasian ideals cannot be 'real'. Plann Theor. 2:37–59. doi:10.1177/1473095203002001005
Holling CS. 2001. Understanding the complexity of economic, ecological and social systems. Ecosystems. 4:390–405. doi:10.1007/s10021-001-0101-5
Homan T. 2001. Teamleren: Theorie en Facilitatie. Schoonhoven: Academic Service.
Horstmann B. 2008. Framing adaptation to climate change: a challenge for building institutions [discussion paper 23/2008]. Bonn: Deutsches Institut für Entwicklungspolitik..

Inman M. 2010. Working with water. Nat Rep Clim Change. 4:39–41.
Innes J. 2004. Consensus building: clarifications for the critics. Plann Theor. 3:5–20. doi:10.1177/1473095204042315
IPCC. 2001. Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Watson RT and the Core Writing Team, editors. Cambridge (UK): Cambridge University Press; p. 398.
IPCC. 2007. Climate Change 2007: The Physical Science Basis. Working Group I Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Cambridge (UK): Cambridge University Press.
Johnson KA, Dana G, Jordan NR, Draeger KJ, Kapuscinski A, Schmitt Olabisi LK, Reich PB. 2012. Using participatory scenarios to stimulate social learning for collaborative sustainable development. Ecol Soc. 17:9. doi:10.5751/ES-04780-170209
Jones R. 2010. A risk management approach to climate change adaptation. In: Rac N, Wratt DS, Bornman JF, Jones K, editors. Climate change adaptation in New Zealand: future scenarios and some sectoral perspectives. Wellington: New Zealand Climate Change Centre; p. 10–25.
Jones R. 2011. Planning with plasticine [Internet]. [cited 2011 Nov 30]. Available from: http://2risk.wordpress.com/2011/11/30/planning-with-plasticine/
Kabat P. 2008. Should the uncertainty in climate scenarios limit adaptation? Presentation on 27 November 2008 during the Congress 'On the Road to a Climate Proof Society' [Internet]; Rotterdam; [cited 2011 May 31]. Available from: http://promise.klimaatvoorruimte.nl/pro1/publications/show_publication.asp?documentid=3388&GUID=bb6eb9d4-1cec-4e48-9af3-d697abc1d213
Kahn H, Wiener A. 1967. The year 2000 a framework for speculation on the next thirty-years. New York (NY): The Macmillan Company.
Kates RW, Clark WC. 1996. Environmental surprise: expecting the unexpected? Environ Sci Policy Sustainable Dev. 38:6–34. doi:10.1080/00139157.1996.9933458
Kates RW, Clark WC, Corell R, Hall JM, Jaeger CC, Lowe I, Mccarthy JJ, Schellnhuber HJ, Bolin B, Dickson NM, et al. 2001. Environment and development: sustainability science. Science. 292:641–642. doi:10.1126/science.1059386
Keys N, Bussey M, Thomsen DC, Lynam T, Smith TF. 2014. Building adaptive capacity in South East Queensland, Australia. Reg Environ Change. 14:501–512. doi:10.1007/s10113-012-0394-2
Klijn EH, Koppenjan JFM. 2000. Public management and policy networks: foundations of a network approach to governance. Publ Manag Int J Res Theor. 2:135–158. doi:10.1080/146166700411201
Kolb DA. 1984. Experimental learning. Englewood Cliffs (NJ): Prentice Hal.
Lab R+E+M. 2008. Grounds for change, Dierenpark Emmen. Assen: Provincie Drenthe.
Lane MB, Mcdonald G. 2005. Community-based environmental planning: operational dilemmas, planning principles and possible remedies. J Environ Plann Manag. 48:709–731. doi:10.1080/09640560500182985
Lange E, Hehl-Lange S. 2005. Combining a participatory planning approach with a virtual landscape model for the siting of wind turbines. J Environ Plann Manag. 48:833–852. doi:10.1080/09640560500294277
Lee KN. 1993. Compass and gyroscope: integrating science and politics for the environment. Washington (DC): Island Press.
Lennertz B, Lutzenhiser A. 2006. The Charrette handbook. The essential guide for accelerated, collaborative community planning. Chicago (IL): APA.
Lindblom CE. 1959. The science of "muddling through". Public Adm Rev. 19:79–88. doi:10.2307/973677
Lindseth G. 2005. Local level adaptation to climate change: discursive strategies in the Norwegian context. J Environ Policy Plann. 7:61–84. doi:10.1080/15239080500251908
Lindsey G, Todd JA, Hayter SJ, Ellis PG. 2009. A handbook for planning and conducting Charrettes for high-performance projects. Washington (DC): National Renewable Energy Laboratory.
Mandell MP, Steelman TA. 2003. Understanding what can be accomplished through interorganizational innovations the importance of typologies, context and management strategies. Public Manag Rev. 5:197–224. doi:10.1080/1461667032000066417
Matthies E, Krömker D. 2000. Participatory planning—a heuristic for adjusting interventions to the context. J Environ Psychol. 20:65–74. doi:10.1006/jevp.1999.0149
Mearns LO. 2010. The drama of uncertainty. Clim Change. 100:77–85. doi:10.1007/s10584-010-9841-6
Meyer R. 2012. Uncertainty as a science policy problem. Clim Change. 110:1–2. doi:10.1007/s10584-011-0050-8
Milford L, Dutcher D, Barker T. 2008. Climate choreography. How distributed and open innovation could accelerate technology development and deployment. Montpelier (VT): Clean Energy Group.
Minx J, Creutzig F, Medinger V, Ziegler T, Owen A, Baiocchi G. 2010. Developing a pragmatic approach to assess urban metabolism in Europe. A report to the European Environment Agency. Stockholm: SEI and TU Berlin.
Mouffe C. 1993. The return of the political [2005 edition]. London: Verso.
Mouffe C. 2005. On the political. New York (NY): Routledge.
Newman P. 2006. The environmental impact of cities. Environ Urban. 18:275–295. doi:10.1177/0956247806069599
Newman P, Beatley T, Boyer H. 2009. Resilient cities, responding to peak oil and climate change. Washington (DC): Island Press.
Newman P, Birrell R, Homes D, Mathers C, Newton P, Oakley G, O'Connor A, Walker B, Spessa A, Tait D. 1996. Chapter 3 – human settlements in Australia. In: Taylor R, editor. State of the environment. Melbourne: Department of Sport and Territories.
Newman PWG. 1999. Sustainability and cities: extending the metabolism model. Landsc Urban Plan. 44:219–226. doi:10.1016/S0169-2046(99)00009-2
Newton P, Flood J, Berry M, Bhatia K, Brown S, Cabelli A, Gomboso J, Higgins J, Richardson T, Ritchie V. 1998. Environmental indicators for national state of the environment reporting – human settlements. Australia: State of the Environment (Environmental Indicator Reports). Canberra: Department of the Environment.
Newton PW, editor. 1997. Re-shaping cities for a more sustainable future, research monograph 6. Melbourne: Australian Housing and Urban Research Institute (AHURI).
Newton PW, Baum S, Bhatia K, Brown SK, Cameron AS, Foran B, Grant T, Mak SL, Memmott PC, Mitchell VG, et al. 2001. Human settlements. Australia State of the Environment Report 2001 (Theme Report). Canberra: CSIRO Publishing on behalf of the Department of the Environment.
Nisbet MC. 2009. Communicating climate change: why frames matter for public engagement. Environ Sci Policy Sustainable Dev. 51:12–23. doi:10.3200/ENVT.51.2.12-23
Niza S, Rosado L, Ferrão P. 2009. Urban metabolism. J Ind Ecol. 13:384–405. doi:10.1111/j.1530-9290.2009.00130.x

Norris FH, Stevens SP, Pfefferbaum B, Wyche KF, Pfefferbaum RL. 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. Am J Community Psychol. 41:127–150. doi:10.1007/s10464-007-9156-6

Odum HT. 1983. Systems ecology, an introduction. New York (NY): Wiley.

Opticon Design Inc. and Lisa Wise Consulting Inc. 2009. Our flagstaff. Land development code rewrite: Charrette summary report. Flagstaff (AZ): Flagstaff City Council.

Olsson P, Folke C, Hahn T. 2004. Socio-ecological transformation for ecosystem management: the development of adaptive co-management of a wetland landscape in southern Sweden. Ecol Soc. 9:2. [cited 2013 May 17]. Available from: http://www.ecologyandsociety.org/vol9/iss4/art2/

Ostrom E. 1999. Coping with tragedies of the commons. Annu Rev Polit Sci. 2:493–535. doi:10.1146/annurev.polisci.2.1.493

Parry ML, Canziani OF, Palutikof JP, Van Der Linden PJ, Hanson CE, editors. 2007. Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change. Cambridge (UK): Cambridge University Press.

Peterson GD, Carpenter SR, Brock WA. 2003. Uncertainty and the management of multistate ecosystems: an apparently rational route to collapse. Ecology. 84:1403–1411. doi:10.1890/0012-9658(2003)084[1403:UATMOM]2.0.CO;2

Pijnappels M, Dietl P. 2013. Circle-2 adaptation inspiration book. 22 implemented cases of local climate change adaptation to inspire European citizens. Lisboa: Circle-2.

Pisano U. 2012. Resilience and sustainable development: theory of resilience, systems thinking and adaptive governance [ESDN quarterly report No 26]. Vienna: ESDN.

Pløger J. 2004. Strife: urban planning and agonism. Plann Theor. 3:71–92. doi:10.1177/1473095204042318

Polman H. 2010. Een duurzame A28. Assen: Ontwerpatelier Grounds for Change, Provincie Drenthe en Regiovisie Groningen-Assen.

Provincie Drenthe. 2006a. Grounds for change Hunzedal Borger. Assen: Provincie Drenthe.

Provincie Drenthe. 2006b. Grounds for change Typisch Vries in Drenthe "de ruggen op, de beken uit". Assen: Provincie Drenthe.

Provincie Groningen. 2009. Provinciaal Omgevingsplan 2009–2013. Vastgesteld op 17 Juni 2009. Groningen (The Netherlands): Provincie Groningen.

Rhodes RAW. 1981. Control and power in central-local government relations. Farnborough (UK): Gower.

Rhodes RAW. 1996. The new governance: governing without government. Polit Stud. 44:652–667. doi:10.1111/j.1467-9248.1996.tb01747.x

Rittel H, Webber M. 1973. Dilemmas in a general theory of planning. Policy Sci. 4: 155–169. Elsevier Scientific Publishing Company, Inc., Amsterdam. (Reprinted in N. Cross (Editor), Developments in Design Methodology, J. Wiley & Sons, Chichester. 1984:135–144.

Roggema R. 2009a. DESIGN, hotspot climate Proof Groningen, final report. Groningen: Province of Groningen and Climate Changes Spatial Planning.

Roggema R. 2009b. INCREASE II. In Proceedings of the Second International Conference on Renewable Energy Approaches for the Spatial Environment. Groningen: UIBE and Province of Groningen.

Roggema R. 2012a. Developing a planning theory for wicked problems: Swarm planning. In: Stremke S, Van Den Dobbelsteen A, editors. Sustainable energy landscapes: designing, planning and development. London (UK): Taylor and Francis; p. 161–185.

Roggema R. 2012b. Swarm planning: the development of a spatial planning methodology to deal with climate adaptation [PhD thesis]. Delft: Delft University of Technology & Wageningen University and Research Center.

Roggema R, editor. 2012c. Swarming landscapes: the art of designing for climate adaptation. Dordrecht: Springer; p. 260.

Roggema R. 2013a. Are we listening? In: Proceedings Climate IMPACTS 2013; May 29–31. Potsdam: Potsdam Institute for Climate Impact Research.

Roggema R, editor. 2013b. The design Charrette: ways to envision sustainable futures. Dordrecht: Springer; p. 335.

Roggema R, Boneschansker O. 2010. INCREASE II; final report of the second international conference on renewable energy approaches for the spatial environment; towards a zero fossil energy region in 2050. Groningen: UIBE and Province of Groningen.

Roggema R, Jones R, Clune S, Lindenbergh D. 2012a. Sea Lake Charrette, primary schools. Melbourne: RMIT University, La Trobe University, Victoria University and VCCCAR.

Roggema R, Jones R, Clune S, Lindenbergh D. 2012b. Sea Lake Charrette, dancing under the stars. Melbourne: RMIT University, La Trobe University, Victoria University and VCCCAR.

Roggema R, Jones R, Soh A, Clune S, Hunter S, Barilla A, Cai Z, Tian J, Walsh J. 2011. City of Greater Bendigo design charrette I, the report. Melbourne: RMIT University, La Trobe University, Victoria University and VCCCAR.

Roggema R, Mallon W, Sergeev V, Swaving G-J. 2008. INCREASE I; towards a climate proof energy System in Groningen. Spatial impact of adjustments to the future energy system. Groningen: Provincie Groningen and Klimaat voor Ruimte.

Roggema R, Martin J, Arcari P, Clune S, Horne R. 2013. Design-led decision support: process and engagement. Melbourne: VCCCAR.

Roggema R, Martin J, Horne R. 2011. Sharing the climate adaptive dream: the benefits of the Charrette approach. In Dalziel P, editor. Proceedings 'ANZRSAI conference'; Dec 6–9; Canberra. Lincoln (NZ): AERU Research Unit.

Roggema R, Martin J, Horne R, Jones R, Hunter S, Soh A, Werner J, Clune S. 2011c. Design brief design Charrette I, City of Greater Bendigo. Melbourne: RMIT University, La Trobe University, Victoria University and VCCCAR.

Roggema R, Martin J, Horne R, Jones R, Soh A, Lindenbergh D, Clune S. 2012. The design brief, sea lake design Charrette I. Melbourne: RMIT University, La Trobe University, Victoria University and VCCCAR.

Roggema R, Stremke S. 2012. Networks as the driving force for climate design. In: Roggema R, editor. Swarming landscapes: the art of designing for climate adaptation. Dordrecht: Springer; p. 91–116.

Roggema R, Van Den Dobbelsteen A. 2006. A green heart in a Red Belt. A bridging to the future design Charette in Jinze. Shanghai: IGU.

Roggema R, Van Den Dobbelsteen A. 2008. Swarm planning: development of a new planning paradigm, which improves the capacity of regional spatial systems to adapt to climate change. In: Foliente G, Luetzkendorf T, Newton P, Paevere P, editors. Proceedings World Sustainable Building Conference (SB08); Sep 21–25; Melbourne.

Roggema R, Vos L, Martin J. Forthcoming. Community based environmental design: empowering local expertise in design charrettes. In: Yan W, Galloway B, editors. Rethinking

resilience, innovation and adaptation in a time of change. Dordrecht: Springer.
Ruitenbeek J, Cartier C. 2001. The invisible wand: adaptive co-management as an emergent strategy in complex bio-economic systems. Occasional Paper 34. Bogor: Center for International Research (CIFOR).
Salter J, Robinson J, Wiek A. 2010. Participatory methods of integrated assessment–a review. Wiley Interdiscip Rev Clim Change. 1:697–717. doi:10.1002/wcc.73
Sanders L. 2006. Scaffolds for building everyday creativity. In: Frascara J, editor. Design for effective communications: creating contexts for clarity and meaning. New York (NY): Allworth Press.
Scharpf FW. 1997. Games real actors play: actor centered institutionalism in policy research. Boulder (CO): Westview Press.
Scottish Sustainable Communities Initiative. 2010. Charrette Series Report [Internet]. [cited 2011 Sep 26]. Available from: http://www.scotland.gov.uk/Resource/Doc/260590/0105938.pdf
Sikkema J, Lucius A. 2010. Van dierenpark naar mensenpark. Assen: Ontwerpatelier Grounds for Change, Provincie Drenthe en Gemeente Emmen.
The State of Victoria, Department of Transport, Planning & Local Infrastructure. 2013. Plan Melbourne; metropolitan planning strategy. Melbourne: The State of Victoria, Department of Transport, Planning & Local Infrastructure.
Staub S. 2012. Co-creatie in gebiedsontwikkeling. Vraaggericht sturen op waardecreëerende bedrijf-consumentrelaties in gebiedsontwikkeling [Internet]. [cited 2013 April 14]. Available from: http://cdn.gebiedsontwikkeling.nu/workspace/uploads/2012.10.12_co-creatie-in-gebie-50da0750c2c58.pdf
Steffen W, Hughes L, Karoly D. 2013. The critical decade, extreme weather. Canberra: The Climate Commission.
Sutton SE, Kemp SP. 2006. Integrating social science and design inquiry through interdisciplinary design charrettes: an approach to participatory community problem solving. Am J Community Psychol. 38:125–139. doi:10.1007/s10464-006-9065-0
Swanson D, Bhadwal S, editors. 2009. Creative adaptive policies; a guide for policy-making in an uncertain world. New Delhi: SAGE.
Thompson JD. 2003. Organisations in action: social science bases of administrative theory. New Brunswick: Transaction Publishers.
Tjallingii SP. 1993. Ecopolis: strategies for ecologically sound urban development. Leiden: Backhuys Publishers.
Tomásek W. 1979. Die Stadt als Oekosystem; Űberlegungen zum Vorentwurf Landschafsplan Köln. Landschaft + Stadt. 11:51–60.
Umemoto K. 2001. Walking in another's shoes: epistemological challenges in participatory planning. J Plann Educ Res. 21:17–31. doi:10.1177/0739456X0102100102
UNDP. 2008. Community based adaptation, A UNDP/GEF project, in partnership with GEF/GSP [Internet]. [cited 2013 Apr 13]. Available from: www.undp-adaptation.org/project/cba
University of British Columbia. 2004. The Squamish downtown waterfront (DRAFT) concept plan, Squamish and Fraser Basin Council Vancouver [Internet]. [cited 2011 Sep 26]. Available from: http://squamish.ca/files/Squamish%20Downtown%20Waterfront%20Concept%20Plan%20sm.pdf
Van Aalst MK, Cannon T, Burton I. 2008. Community level adaptation to climate change: the potential role of participatory community risk assessment. Global Environ Change. 18:165–179. doi:10.1016/j.gloenvcha.2007.06.002
Van Dam F, Noorman KJ, editors. 2005. Grounds for change: bridging energy planning and spatial design strategies. Groningen: Charrette Report Grounds for Change Design Charrette.
Van Den Berg A. 2010. Kiemland. Assen: Ontwerpatelier Grounds for Change, Provincie Drenthe en Gemeente Meppel.
Van Der Gaag M, Snijders TAB. 2005. The resource generator: social capital quantification with concrete items. Social Networks. 27:1–29. doi:10.1016/j.socnet.2004.10.001
Van Der Leeuw SE. 2000. Land degradation as a socio-natural process. In: Mcintosh RJ, Tainter JA, Mcintosh SK, editors. The way the wind blows: climate, history and human action. New York (NY): Columbia University Press; p. 357–383.
Vos L. 2013. Innovations in collaborative and community learning. In: Roggema R, editor. The design Charrette: enhancing community resilience. Dordrecht: Springer; p. 35–60.
Waddenvereniging. 2009. Schetsschuit Zuidwest Ameland. Veiligheid en Natuur Hand in Hand. Harlingen (TX): Waddenvereniging.
Waddenvereniging. 2010. Schetsschuit Texel. Naar een Klimaatbestendige Waterhuishouding. Harlingen (TX): Waddenvereniging.
Walker B, Carpenter S, Anderies J, Abel N, Cumming G, Janssen M, Lebel L, Norberg J, Peterson GD, Pritchard R. 2002. Resilience management in social- ecological systems: a working hypothesis for a participatory approach. Conserv Ecol. 6:14. Available from: http://www.consecol.org/vol6/iss1/art14
Walker B, Holling CS, Carpenter SR, Kinzig A. 2004. Resilience, adaptability and transformability in social-economic systems. Ecol Soc. 9:5. Available from: http://www.ecologyandsociety.org/vol9/iss2/art5/
Walker B, Salt D. 2006. Resilience thinking. Washington (DC): Island Press.
Westley F. 1995. Governing design: the management of social systems and ecosystems management. In: Gunderson L, Holling CS, editors. Barriers and bridges to the renewal of ecosystems and institutions. New York (NY): Columbia University Press; p. 391–427.
Westley F, Carpenter SR, Brock WA, Holling CS, Gunderson LH. 2002. Why systems of people and nature are not just social and ecological systems. In: Gunderson L, Holling CS, editors. Panarchy: understanding transformations in human and natural systems. Washington (DC): Island Press; p. 103–119.
Wildemeersch D, Jansen T, Vandenabeele J, Jans M. 1998. Social learning: a new perspective on learning in participatory systems. Stud Contin Educ. 20:251–265. doi:10.1080/0158037980200210
Wilkinson C. 2012. Social-ecological resilience: insights and issues for planning theory. Plann Theor. 11:148–169. doi:10.1177/1473095211426274
Wolman A. 1965. The metabolism of cities. Sci Am. 213:178–190. doi:10.1038/scientificamerican0965-178
Wong THF, Brown RR. 2009. The water sensitive city: principles for practice. Water Sci Technol. 60:673–682. doi:10.2166/wst.2009.436
Young OR, Berkhout F, Gallopin GC, Janssen MA, Ostrom E, Van Der Leeuw S. 2006. The globalization of socio-ecological systems: an agenda for scientific research. Global Environ Change. 16:304–316. doi:10.1016/j.gloenvcha.2006.03.004