Planning of sport and recreational facilities informed by interdisciplinary knowledge
An attempt to make a systematic and transparent design strategy

Mikkel Hjort
Department of Sports Science and Clinical Biomechanics,
University of Southern Denmark, Odense, Denmark

W. Mike Martin
Department of Architecture,
University of California – Berkeley, Berkeley, California, USA, and

Jens Troelsen
Department of Sports Science and Clinical Biomechanics,
University of Southern Denmark, Odense, Denmark

Abstract
Purpose – The purpose of this paper is to develop a design strategy that investigates the systematic use of interdisciplinary knowledge through a transparent decision-making process. The study identifies relevant design parameters that should be considered in the development of this design strategy.

Design/methodology/approach – The empirical data were collected through observations of the design process of two new sport facilities, meetings with sport, well-being and aging experts and through semi-structured interviews with end-users. The development of the proposed design strategy is based on a methodology with elements from “Knowledge to Action (KTA),” “Action research” and a “List of value concepts.” The rigid timetable guaranteed systematic progress, where both knowledge from the end-users and experts were incorporated throughout the decision-making process.

Findings – The two case studies documented results involving end-users and experts in a systematic way. In conclusion, it was apparent that the use of interdisciplinary collaboration informed the design outcome.

Practical implications – Based on the two cases, the following advice can be given to the architectural profession: architects should use the KTA model or similar in order to target the search for relevant interdisciplinary knowledge and ensure that relevant evidence is involved in the design process of upcoming projects regarding sport and recreation. Architects should make the design process transparent so that one can see which design decisions have been made through the design process. This must be done to ensure that there is greater coherence between vision and practice.

Originality/value – The study showed how architects could import knowledge, skills and values from other disciplines such as environmental psychology and active living research to improve the decision-making process of future sport and recreation projects. It was also clear that this design decision process could be made more transparent in the effort to allow the various stakeholders to take ownership of the resulting design outcomes.

Keywords Interdisciplinary collaboration, Environmental psychology, Active living, Evidence-based design, Transparent design process

Paper type Research paper

1. Introduction
According to WHO (2018), insufficient physical activity is one of the leading risk factors for death worldwide. From a historical perspective, health promotion initiatives, including enhancing physical activity, have mainly been promoted on the basis of individuals. It is now recognized that the impact of physical activity can not only cause personal behavioral change, but also, in recent years, there has been an increased awareness of how and to what
extent the physical environments for sport and recreation can affect the nature of physical activity (Davison and Catherine, 2006). Interdisciplinary research has highlighted some of the factors that architects should prioritize when designing facilities for physical activity and recreation. It is, however, unclear to what extent the translation of this health professional’s knowledge about physical activity behavior has resulted in the appropriate physical environment solutions that support the specific intended behavior, as architects generally create places for human interaction and action based on their tacit knowledge and experience (Roessler, 2003).

Architects argue that research can improve design, based on positive results in other disciplines such as health care design (Zimring et al., 2008). Numerous studies have shown how the physical environment can relieve pain and stress, improve mental well-being and job satisfaction and motivation through physical activity and movement (Corazon et al., 2018; Sallis et al., 2012; Bechtel and Churchman, 2003; Kaplan et al., 2005). This strategy has particularly gained ground in the design of hospitals, where evidence-based design is the method used by architects to plan and evaluate the design process. Design decisions are based on creating the best possible solutions through knowledge and application of best practice (Brown and Corry, 2011).

Even though it can be argued that design decisions are often grounded in general concepts and aesthetic considerations rather than scientific evidence, several researchers advocate that the architectural profession is on the verge of becoming a more knowledge-based discipline (Hjort et al., 2018; Brown and Corry, 2011). This implies an increased use of interdisciplinary knowledge to inform design strategies and manage the creation of the urban environment. Practitioners of course already use evidence to back up their decisions, but this evidence is primarily from their own field and focuses primarily on the building performance (Chong et al., 2013). Several researchers in the field of architecture point at the absence of linkages between practicing architects and the academia (Brown and Corry, 2011).

According to John Habraken (2006), architects are missing a clearly defined method of collaboration with other disciplines in a structured and mutually agreed way, so the gap between the different sciences can be closed in the future. Thus, practicing architects do not use the latest research and interdisciplinary knowledge (Watson and Grondzik, 1997). Only few research projects are conducted in the interdisciplinary field between architecture and environment psychology, but there are good examples that point in the direction of a future collaboration between different fields. One example is in the paper “Outdoor environments at Crisis shelter” where relevant research is integrated in the design implications (Lygum et al., 2013).

In order to enhance performance in future sport and recreation facilities, knowledge and research from other disciplines must be embedded in the design process (Roessler, 2003). Architects embrace the calls for interdisciplinary collaboration. Environmental psychologists for a long time have advocated that it is difficult for design practitioners to apply new findings from environmental psychology to their work because the path of application has not been clearly described (Russell and Ward, 1982). Consequently, environmental psychology researchers must encourage the application of their new knowledge by advocating more clear application strategies like audience targeting, better dissemination and more accessible reports (Edgerton et al., 2007). At the same time, researchers in physical activity behavior and active living often experience that their research is used retrospectively to justify a position instead of being used proactively in the design decision process. Therefore, there is a need for strategies that can bridge the gap between active living research and architects (Giles-Corti et al., 2014).

In order to implement these recommendations in future sport and recreation projects, a new design approach is required (Habraken, 2006). This design approach must enable
architects to incorporate current research and knowledge from other relevant disciplines into the decision-making process in a systematic and rigorous manner.

The aim of this study was to investigate a design approach, which can ensure a more systematic use of interdisciplinary knowledge through a transparent design process. The design approach is illustrated in Figure 1, where the operationalization of the strategy during the design process is described, from vision to final proposal. The study will identify relevant factors that should be considered in the development of a new decision-making strategy that can guide architects. This leads to the following research questions:

RQ1. How can a systematic use of interdisciplinary knowledge be ensured?

RQ2. What factors should a new design decision approach contain in order to meaningfully engage other disciplines?
The proposed strategy will be tested and evaluated in the design of two new sport and recreation facilities in the municipality of Nyborg and Slagelse in Denmark. In this paper, the title architect covers landscape architects and urban planners in order to simplify the understanding.

2. Methodological background

The development of the proposed design strategy is inspired by Action research (Berg and Lune, 2017; Creswell and Creswell, 2018). In addition, surveys are used to collect data (Thomas, 2016). To navigate the design process elements from “Knowledge to Action (KTA)” are used (Bowen and Graham, 2013), and in order to guide the surveys a “List of value concepts” are explained (Fischer, 1995). The background for this methodological synthesis is described in the following section.

Action research

The term Action research was mentioned for the first time in 1944, where Kurt Lewin described the method as a comparative research method of various forms of social action and research leading to social change (Lewin and Cartwright, 1990). Traditionally, Action research takes a political position based on an urge to change the conditions for socially oppressed (Freire, 2018). In this study, there was no political ambitions, but Action research was selected, because the study tried to change existing facilities through active involvement of local citizens (Creswell, 2003).

In this study, Action research is used to make interaction with the local citizens and interdisciplinary experts to gain a broader and more comprehensive understanding of their needs and recommendations. As mentioned in the Introduction, architects and researchers can benefit from the application of new knowledge in order to embed the knowledge in an ongoing design process. A method that enables the researcher to get closer to the process and the local citizens is by using the Action research method. This method allows the researcher to embrace principles of participation, reflection and emancipation of individuals interested in improving their conditions (Berg and Lune, 2017), and, at the same time, it ensures that real people are engaged in the study (Coghlan and Shani, 2005). The method has been found to be fruitful because it is reflective and allows room for changes as the process progresses. During a process, all participants involved in the project are considered as contributing actors in the research initiative (Wadsworth and Action Research Issues, 1993). Action research is not a rigorous organized method, where the next step is totally planned beforehand. Instead, the method guides the next step along the way in a reflective process, where real problems bridge the gap between research and application (Cortés and Sommer, 2016).

Surveys

Surveys are defined as a research method used for collecting primarily quantitative data from a particular group of people. Surveys have a number of predefined purposes and can be performed in many ways, depending on the method used (Thomas, 2016). In a survey, it is important to collect data systematically, so the same characteristics are measured for each participant in exactly the same way. This is done in order to avoid prejudiced opinions that could affect the outcome of the study (Bryman, 2008).

In this study, local citizens were given a double role because they were also asked to complete a number of surveys in addition to participating in Action research. After the surveys were completed, the results were processed and average values were calculated for the various questions. The average value represented an average of the local citizens’ answers.
Knowledge to Action

KTA is a term proposed by the Canadian Institutes of Health Research. In their definition, knowledge is not only limited to research, but also includes interaction between researchers and knowledge users (Sudsawad, 2007). To enhance quality of architecture and to secure specific use of a given facility, objective knowledge must be embedded in the design process. In order to make KTA work in an architecture firm, the gap between the existing objective knowledge about sport and recreational sites and the subjective knowledge architects use must be closed (Bowen and Graham, 2013). To do this, the knowledge that exists about sport and recreational sites must be identified and transferred to architects. This process takes place in a complex system of interaction between researchers and those who need knowledge. The process will vary in intensity, complexity and engagement depending on what is needed. It is often proposed that research is not used because it is difficult to transfer to the end-users (Bowen and Graham, 2013). Before the knowledge can be disseminated, it is, therefore, important that there is interaction between architects who need input, and researchers who have the necessary knowledge about sport and recreational facilities, so the combined knowledge can be tailored to the design making aligned with the need of the end-users (Graham et al., 2006).

Value concepts

Some psychiatrists have described environmental psychology as a contributor to sustainability science and urban planning (Gifford, 2007). People have needs, which vary from person to person. A need expresses something that is missing, and the need is often associated with the experience of a deficiency to be met. These needs are addressed in environmental psychology. The research field is relatively new and has focused on the interaction between the man-made world and human behavior. Human senses are influenced in many ways by architecture. We experience shapes and colors, feel or smell materials (Roessler, 2003), but it is difficult to transfer human needs to the requirements needed in specific projects. Manfred Fischer has tried to categorize seven value concepts for human performance that are essential in correlation to the built environment. The value concepts can be transferred to the requirements of planning for new sport and recreation architecture (Fischer, 1995). The different categories are described the following way, and conceptualized in Figure 1 as a model to grasp the complexity of how the value concepts intervene with the KTA model and utilized in an Action research study design.

Seven value concepts

1. Safety: a basic safety need that architects must prioritize in any aspect of the design process.
2. Clarity: a space must be easy to read and understand. Spaces must be manageable and the functionality must have a clear hierarchy in order to determine what is most important.
3. Privacy: spaces must be divided into semi-private and semi-public spaces in order to make different atmosphere that gives the space identity.
4. Stimulation: people need stimulation of mind and body in order to evolve.
5. Social interaction: an important need for humans – spaces can both invite or exclude social interaction.
6. Comfort: the demand for comfort is today a growing demand for humans.
7. Identity: identity is a basic need because it defines our history.
The model
This study explores a new design strategy in depth through Action research, where a new decision-making process is tested and explored in a real-world setting. A collaboration between a municipality, local citizens, experts and the lead author (landscape architect) of this paper will define and improve the suggested design strategy through two case studies. Figure 1 is an Action research model to visualize how to incorporate interdisciplinary knowledge into the design process, and how the use of dilemmas, value concepts and scenarios intervenes the design process to ensure focus on physical activity behavior.

The model is inspired by the KTA model and is used to navigate the design process. The model can help identify relevant questions through the process, and, at the same time, the model also ensures that the interdisciplinary knowledge generated by the questions is translated and implemented in the design process.

The data are collected through a triangulation between experts (objective evidence), the architect (subjective evidence) and the local citizens’ needs (guardians for the program). In the study, quantitative data were collected in order to evaluate the advancement of the design process. This methodological approach can be characterized as synthesis of existing research on sport and recreational facilities, theory, interdisciplinary collaboration, tacit knowledge and best practice into the design process.

3. Methods
The empirical data consist of observational data earned through the workshops, score card data generated through surveys and interview data collected as part of a design process of two new sport and recreation facilities. In the following section, the methodical considerations and procedures will be described.

Study sites
Prior to the study, three municipalities were asked if they would participate in the study. To make it beneficial for the municipalities, landscape architect consultation was offered free of charge during the design process including facilitating three workshops. In return, the municipalities had to fulfill three criteria: offer a relevant sport and recreation project; offer an empty building site for the future facility; and provide financial support to the project. Fortunately, two municipalities, Nyborg and Slagelse, agreed to participate with projects that corresponded to these requirements (Plate 1).

Municipality of Nyborg
Ørbæk is a small village outside Nyborg with approximately 1,600 inhabitants. The village has a busy sport complex offering traditional organized sport activities like fitness training,

Plate 1.
The sites – municipality of Nyborg and Slagelse
handball and football. Adjacent to the sport complex, there is an empty site, where the municipality wanted to develop a facility for unorganized sport and recreation. The site is situated next to a public school and has a central place in the village. There is a playground for children near the site. The main target groups who should be able to use the facility were teenagers, adults and seniors unfamiliar to organized sport, and also families with children. Because of the wide user group, the municipality asked for a facility not only allowing users to be physically active, but also allowing space for recreation and observers.

**Municipality of Slagelse**

Slagelse is a town with 34,000 inhabitants. There is a large sports complex in the center of the town with a wide range of organized sports activities. Adjacent to the complex, there is an old running track. The track has been transformed into a facility, where the city can store storm-water, when the sewers are flooded. Thus, landforms have been built around the track to provide a boundary for water retention. The municipality wished to transform the old running track into an innovative recreational park for organized and unorganized activities for a wide group of users. The main target groups were children and seniors, who could socialize across age and gender with special focus on intergenerational interaction. But other user groups were also invited, making the objectives for the design open.

**Study design**

To evaluate the design process, outcome data were collected with the use of observations of the Action research activities, including local citizens’ surveys during the two workshop courses. This was followed up by telephone interviews with two local citizens, who had participated in the workshops.

**The design process**

The design process adopted an iterative approach (Kumar, 2013) and was anchored around three workshops. The workshops were scheduled over a period of two months, with approximately four weeks between each workshop. Before the first workshop, a thorough site visit was conducted in order to get a detailed understanding of the site. A project leader from the municipalities also attended the workshops representing the stakeholder. The lead author facilitated the process during all workshops. The disadvantages of the chosen role as both facilitator and observer is the risk of the empirical data being superficial and ethnocentric (Thing, 2013). Between the workshops, the lead author prepared the material, design proposals and was in dialogue with co-authors and external experts about the process. Throughout the process, we used the following agenda to organize the workshops: formulation of a clear research question and setting clear objectives; identification of existing knowledge about sport and recreational through literature and expert talks (Kumar, 2013, p. 3); evaluation of the knowledge found in order to identify what could be used; and finally application of the findings to the current design project. Integration of relevant knowledge after the workshops should not only help to develop the basis for KTA, but also secure a more systematic use of the knowledge (Graham et al., 2006).

**Participations**

The local citizens were invited to join the workshops through digital media and physical postings in local sports associations, this way we did not know who would participate beforehand. The design team consisted of the lead author and three experts. One with knowledge about mobility design for seniors, one with knowledge about well-being in general and one with knowledge about specific training. After each workshop, feedback from local citizens was presented for the interdisciplinary experts to get advice and recommendations.
The experts were chosen according to their field of expertise, and their inputs were applied according to the phase of the design, where they could benefit most. For example, did the expert in training not participate until later in the process, where his knowledge could inform the specific design outcome. The expert knowledge was then incorporated into the design before the next workshop as illustrated in Figure 2. In this paper, the term expert only includes people with an educational background of the PhD level within the described area, but it can also include experts with a more experience-based knowledge, as the purpose of involving experts mainly was to inform the design process through relevant inputs.

Workshop 1
At the first workshop, the local citizens were presented with a list of different dilemmas in order to make them known about the challenges of the site. The dilemmas were presented like the semantic differential scale (Mehrabian and Russell, 1976). An example of a dilemma could be whether the future site should mainly be for adults and seniors or for children and teenagers (see Figure 3). The local citizens were presented with 15 dilemmas and asked to grade them. After the workshop, the dilemma assessments were collected to evaluate how the local citizens envisioned the site. The use of the dichotomized semantic differential scale made it simple to determine what the local citizens preferred.
Workshop 2
At the second workshop, the local citizens were presented with three scenarios of a future design to incite reflections on the design solutions. Each design was prepared on the basis of the output of the dilemmas. Each scenario presented a different design concept and offered different functionalities and activities. The local citizens were asked to grade the different scenarios according to the value concepts to find out how well the design facilitated the specific values. The local citizens were also asked to write down what they thought about the design, in general. The grading made it possible to quantify what the local citizens preferred to a greater or a lesser extent.

Workshop 3
At the third and final workshops, the local citizens were presented with the final design based on the result of the scenarios. The final design was a mix of all the positive design solutions from the scenarios, whereas the negative solutions were neglected. The participants were asked to grade the final design according to the seven value concepts (Plate 2).

Telephone interviews
In order to gain knowledge about the design process, semi-structured telephone interviews were conducted with two local citizens after the last workshop. One from each case study. The persons were identified from the list of local citizens. An interview guide was developed for the semi-structured qualitative interviews containing a list of five questions. The guide focused primarily on two themes: involvement in the design process and perception of the value concepts. The fact that the interviews were semi-structured meant that the interviewer followed a pre-prepared interview guide, and could deviate from it, if interesting themes appeared that could be exciting to pursue (Brinkmann and Tanggaard, 2015).

4. Results
During the two different case studies, the lead author facilitated three workshops in each municipality in order to involve the local citizens in the design process. According to the timetable, the project in the municipality of Nyborg was considered as a pilot study and the latter project in the municipality of Slagelse as the final project, where the design approach could be validated. The numbers of local citizens participating ended up being almost the
same in each project ranging from 8 to 12 participants. Between the two case studies, the
process was improved according to the experiences made in the first case study in
municipality of Nyborg.

*Municipality of Nyborg*

*Workshop 1 – Municipality of Nyborg.* At the first workshop nine local citizens participated.
The group was divided into an equal number of males and females ranging from
approximately 16 to 70 year old. The people were all potential end-users but had all different
relations to the project. Some of them used the existing facility for sport and recreation,
some of them were volunteers working in the sports complex and some of them worked at
the nearby school. Before the actual workshop, the concept of active living was presented in
order to make the citizens realize the importance of active behavior. This was a good start
and gave the citizens a sense of involvement and eagerness to start the process. During the
workshop, the citizens worked focused on the dilemmas, where they filled out the semantic
differential scales. The dilemmas covered everything that could influence the use of the
facility, e.g., choice of activities, main age groups the facility should focus on, and also
design approaches. Overall, the scorings gave an initial idea of what kind of facility the local
citizens envisioned.

At the end of the session, during the informal talk, some of the citizens were very specific
in their suggestions for future initiatives. One end-user said: “It could be cool with a cable
connection the site.” Another citizen suggested a climbing tower. These ideas showed
early enthusiasm from the citizens and also some very specific design ideas.

*Workshop 2 – Municipality of Nyborg.* Between the first and second workshops, we
prepared three scenarios offering different facilities and aesthetics according to the semantic
scale. These scenarios were presented to two experts. An architect specialized in mobility
design for seniors and a sports expert specialized in health and well-being. Examples of
expert recommendations are as follows: architect: “Overview of the space will give the
seniors a sense of safety.” Sports expert: “My suggestion would be that the area not only
consists of innovative facilities, but also recognizable things like a basketball court, parkour
facilities, etc.” Their advice was incorporated into the scenarios.

At the second workshop, nearly the same group of people participated. The three
scenarios were presented, and the citizens graded each scenario from 1 to 5 according to
value concepts (see Figure 4). The third scenario, The square, scored best according to
citizens. The results also correlated with written responses, where the local citizens, in
general, felt that the square offered most activities for all age groups. A common finding
was also that the local citizens replied very specifically to the actual design of the
scenarios. One end-user wrote: “The design of the urban square is very linear and could be
more organic.”

*Workshop 3 – Municipality of Nyborg.* Between the second and third workshops, the final
proposal was prepared incorporating feedback from the second workshop. Using the
grades, it was simple to determine which scenarios were most preferred and identify the
value concepts with the lowest ranking. The final proposal was presented to the same
experts, and their recommendations were then incorporated in the final proposal.

Eight local citizens participated in the third workshop. The final proposal was presented
and again the citizens were asked to grade the proposal according to the value concepts. The
results are shown in Figure 4. The citizens seemed satisfied with the final proposal, even
though it scored lower than Scenario 3. At the end of the session, the citizens were asked
about the process. They responded that, in general, they felt integrated and heard
throughout the process, but a few of them also said that the value concepts were difficult to
understand. The missing cable car was mentioned again, so it was parked as a future option.
**Telephone interview – Municipality of Nyborg.** The local citizen (female) said: “I think the process was exciting, and that it was nice that so many people had different thoughts, but in the end everybody agreed on a common goal.” The citizen also felt that she had been involved in the design process and that she could see the initial ideas in the final proposal. Throughout the process, there was a good progression, and after each workshop, there was a good evaluation. She understood the value concepts, but said: “The value concepts were difficult to understand in the beginning, but after an explanation, it was fine.”

<table>
<thead>
<tr>
<th>Value concepts</th>
<th>Scenario 1 (The urban)</th>
<th>Scenario 2 (The park)</th>
<th>Scenario 3 (The square)</th>
<th>Final proposal (5 replies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>3.6</td>
<td>3.8</td>
<td>4.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Clarity</td>
<td>3.6</td>
<td>3.4</td>
<td>4.2</td>
<td>4.0</td>
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<tr>
<td>Privacy</td>
<td>3.2</td>
<td>3.0</td>
<td>2.6</td>
<td>2.4</td>
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<tr>
<td>Stimulation</td>
<td>3.2</td>
<td>3.4</td>
<td>3.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Social interaction</td>
<td>3.2</td>
<td>3.3</td>
<td>4.0</td>
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<tr>
<td>Comfort</td>
<td>3.0</td>
<td>2.8</td>
<td>3.8</td>
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<tr>
<td>Identity</td>
<td>2.6</td>
<td>2.8</td>
<td>3.9</td>
<td>3.2</td>
</tr>
</tbody>
</table>

**Figure 4.** Example of scenarios presented at the second workshop, and the final proposal presented at the final workshop.
She thought the value concepts gave meaning according to the design process, especially after the values were understood.

Findings – Municipality of Nyborg. The scores were used to inform the final proposal. Ideally, the scores were expected to be better in the final proposal; however, that is not the case in this project. The local citizens also ranked the values in order of importance. They ranked the values in the following order according to personal preferences: stimulation, social interaction, safety, comfort, identity, clarity and privacy. The value “stimuli” was most important for them, and therefore, we had a special focus on stimuli in the design process.

After the workshops in the municipality of Nyborg, the process was evaluated, and it was concluded that more explanation during the workshop was needed. It was highlighted that the local citizens had difficulties in understanding the importance of their grading. Thus, in the following case study, the design elements were explained more thoroughly, and in addition, the local citizens were also informed, in detail, about the how to assess and how the grading influenced the design process.

Municipality of Slagelse

Workshop 1 – Municipality of Slagelse. In total, 11 people participated in the first workshop. The project leader from the municipality had announced the workshop at the municipality level and inspired his colleagues to participate. Therefore, half of the local citizens were employees from different departments in the municipality. The second half were neighbors with concerns about potential noise related to the facility. The lineup of participants challenged the process, as the municipal employees raised work-related questions, the neighbors worried about the facilities and how it would impact on the area.

In contradiction to the first case study in the municipality of Nyborg, the value concepts were introduced more thoroughly at this workshop, and the dilemmas were organized around the value concepts, so the citizens gave specific feedback on the different values: safety, privacy, stimulation, social interaction, comfort and identity. The value clarity had been neglected because the local citizens in the pilot study (Nyborg) had expressed doubt about it.

At the end of the session, the program went from formal to informal, and the conversation circled around noise and safety issues leaving little room for idea generation.

Workshop 2 – Municipality of Slagelse. Between the first and second workshops, the process was repeated from the pilot study, where three different design solutions called Scenarios 1, 2 and 3 were prepared. More or less the same group of people participated in this workshop. The local citizens were asked to grade the three scenarios according to the value concepts on a scale from 1 to 5. The results are shown in Figure 5. The second scenario, Furniture, scored best according to local citizens. The result does not fully correspond with the written responses because the local citizens in general made very specific comments on a general level. One end-user wrote: “Move the café area away from the residential area,” and another one marked: “Be aware of safety for small children.”

Workshop 3 – Municipality of Slagelse. Between the second and third workshops, the final proposal was prepared, and experts were involved. One expert said: “Because the facility is not designed for a specific target group, there is a risk that no one will take ownership of the area.” To avoid this, specific areas for different target groups were developed.

Nine local citizens participated in the third workshop. The final proposal was presented, and again they were asked to grade the proposal according to the value concepts. In this case study, the final proposal scored better than the scenarios as shown in Figure 5. The citizens seemed, in general, satisfied with the final design, and no neighbors complained about the future noise the facility could produce.
At the end of the session, the citizens were asked about the process. They responded that they, in general, felt integrated and heard throughout the process; however, one woman felt disappointed. She explained: “I had expected that the project would be further developed at this point.”

**Semi-structured telephone interview – Municipality of Slagelse.** The local citizens (male) thought the workshops were all right, especially the first workshop. He said: “I was most
involved in the first part, but was not involved in the creative process of further development.” He felt though that he had been involved in the idea generation process. The final proposal looked very good and developed all the different ideas. He thought the value concepts were easy enough to understand because of the thorough descriptions. He said “The value concepts gave good meaning, since the project was for sports and recreation.” However, he thought a discussion about a digital layer in the park was missing.

Findings – Municipality of Slagelse. The local citizens graded the scenarios after the second workshop and we used the grading to inform the final proposal. The final proposal has the best score because the design process is informed by the three scenarios. The citizens also ranked the values in order of importance. They ranked the values in the following order according to personal preferences: social interaction, stimulation, safety, comfort, privacy and identity. The value social interaction was most important for them, and therefore, we had a special focus on social interaction in the design process.

Overall findings across the two studies
A synthesis of the two studies has shown that a transparent design process can ensure a systematic and structured use of interdisciplinary knowledge. The design process was informed by the quantitative inputs from the local citizens, and according to the value concepts, the final proposal in the latter case study succeeded in raising the values compared to the three scenarios (Figure 5). A synthesis of the two sub-studies showed that there is a need for a transparent design process that can ensure systematic and structured involvement of evidence. In the following chapter, the findings will be discussed.

5. Discussion
The study showed an outline of a future design approach, but the study also highlighted some of the factors that must be improved or modified to ensure that the latest research and knowledge from other disciplines can be embedded in the design process. First of all, interdisciplinary collaboration must be improved, and architects must look toward other professions such as environmental psychology and active living research in order to improve the planning process of future sports and recreation projects.

Second, the design process must be made more transparent in the effort to share and use the collected knowledge in future projects. The use of surveys, where score card with semantic scales and value grading were a method to systematically collect data, highlights the local citizens’ knowledge more objectively. In this study, expert opinions and Action research activities forced the architect to reveal and elaborate tacit knowledge into the design process. Overall, the study showed that it is possible to make the design process more transparent and improve a common understanding of the planning process.

Interdisciplinary collaboration
The local citizens had a pivotal role in making sport facilities functional evident; however, there is also a downside of letting the design be informed only by users’ actual needs. The workshops also showed that the local citizens were very specific and at the same time very general in their design comments. One local citizen wrote: “The design of the urban square is linear and could be more organic.” In this situation, the architect should be sensible, but not let the local citizens fully dictate the design output with regard to the local citizens’ limited knowledge about spatiality, styling, maintenance, etc. Another pitfall is expectations of unrealistic ideas like the example with the cable car. This specific idea was not integrated in the final proposal, and the local citizen felt overruled. Therefore, it is important that the architect can match expectations and align the appropriateness of specific suggested outcomes. The professional design knowledge must be explained and shared in a transparent manner so local citizens understand the scale and the rationale of the decision-making process.
The experts in this study were chosen on behalf of our assessment of their professional capacities. It can be argued that involvement of other experts would have led to other recommendations to the specific project. The experts were involved primarily to inform and qualify the design process. A side effect was it forced the researcher as part of the Action research processes to elaborate on different design solutions and next argued for and against in the decision making. In this way, the process became more transparent and the rationale behind the design was elaborated. The involvement of experts demonstrated how the tacit knowledge can be transformed to a more evident basis for decision.

The KTA model used in this study secured a rigorous design process, where interdisciplinary knowledge was brought into the design process at the right time. The model has guided the iterative process, where knowledge was shared through a triangulation between experts, local citizens and the architect. According to the definition of KTA, knowledge is not limited to research, but also includes interaction between researchers and the users of the collected knowledge (Sudsawad, 2007).

**Transparent design process**

The new design approach investigated if a triangulation between the citizens' input and the experts' advice could be collected as objective knowledge. This was done in order to create more transparency in the design process, so it is possible to collect objective knowledge that can both ensure progress in the project and generate knowledge that can be used in future projects. Before the case studies, it was hypothesized that a transparent design process would enhance the quality of the project and more important enable architects and researchers to gather valued knowledge from the process.

In the natural science disciplines, evidence is based on strict scientific documentation. In comparison, the architectural profession applies evidence if it is well founded in a broad set of contexts. In this study, a triangulation of tacit knowledge, interdisciplinary knowledge and recommendations from local citizens have equally been used to inform the design process. Tacit knowledge relies on long-time education and professional work with design and architecture. The interdisciplinary knowledge was collected through the involvement of specific experts in architecture and sport science, and finally recommendations from the local citizens were collected based on their own experiences and needs. To generate a more evidence-based design strategy, we suggest that information must be transparent, accessible and understandable, so others can make critical judgments about applicability to own case. It is challenging for designers and architects to learn from similar projects and to build professional capacity if knowledge is opaque and inaccessible (Hjort et al., 2018). With limited insight, architects can only be inspired by the aesthetics and less by the rationale behind the functionality of a project.

In this study, the use of dilemmas and value concepts served the purpose to incorporate interdisciplinary knowledge originated from environmental psychology. In the first case study, the local citizens had difficulties understanding the value concepts, but after a more thorough explanation, they were taught to understand the value concepts. This was made especially clear in the interview in the latter case study in the municipality of Slagelse, where the local citizen said: "The value concepts were easy to understand, because of the thorough descriptions." Together with the method with the semantic scale, the use of scoring cards is promising to collect subjective knowledge and turn it in the direction of generalizable, objective knowledge in a transparent way. This can be considered as an objective way of evaluating the design proposal. The different scenarios were informed by the grades given by the local citizens, and the architect can learn from the process by analyzing the quantitative data. The systematic design process enables other architects to gather valued information from the projects afterwards. In order to do so, the architect must investigate the design progress between the workshops and not only look at the final proposal.
Methodical reflections
To strengthen the empirical basis and the voice of the local citizens, it would be beneficial with large numbers of participants representing all potential target groups. In our study, however, we had a relatively small number of local citizens participating in the workshops. To have statistical power, we needed at least 30–40 participants per site to complete our initial idea of using statistics in the decision making. Based on statistical significance calculations, the voice of the local citizens would have stronger impact, but on the contrary too large numbers would conflict with the principle of Action research (Reason and Bradbury, 2013). In our study, the participation of 9 to 11 local citizens was a productive unit and manageable to facilitate, so all felt included and part of the design process. The local citizens had a double role, as they were also asked to complete a number of surveys in addition to participating in Action research. It was also experienced that it was difficult for the local citizens to change between their double role as local citizens and respondents to the surveys. Several times, the citizens did not respond to the survey but instead began to discuss other needs and design options.

Based on this experience, I would choose to separate the two forms of investigation in future studies, so Action research and surveys were separated. The strength of this study must primarily be seen in the rigorous and systematic way in which interdisciplinary knowledge was integrated in the design process based on the new design approach. We cannot conclude, whether the results are better in this project compare to a project plan with a traditional design process, but what we can conclude is that the due to the transparency we can see the reasons for taking specific design decisions. This experience can be used in future projects.

6. Conclusion
The aim of this study was to develop a design strategy that could ensure a more systematic use of interdisciplinary knowledge through a transparent design decision-making process. The use of interdisciplinary collaboration was utilized through a rigorous work process, where experts were involved in a systematic manner after each workshop. The rigid timetable guaranteed systematic progress, where both knowledge from the local citizens (subjective knowledge) and experts (objective knowledge) were incorporated throughout the design process. The two case studies both showed good results in involving local citizens and experts in the design process. The latter case study in the municipality of Slagelse was most successful based on grades given during the workshops and scores of the final proposal. The empirical data are consistent but vague in numbers, so the inclusion of more objective data would strengthen the conclusion.

7. Implications for practice and future research
This study is an example of how to develop of a new design strategy, but more interdisciplinary collaboration and research are needed to make further progress in this field. Based on the two cases, the following advice can be given to the architectural profession:

- Architects should use the KTA model or similar in order to target the search for relevant interdisciplinary knowledge and ensure that relevant evidence is involved in the design process of upcoming projects regarding sport and recreation.
- Architects should make the design process transparent so that one can see which design decisions have been made through the design process. This must be done to ensure that there is greater coherence between vision and practice.

After construction of the two facilities presented in this study, it is highly relevant to collect data to investigate the ongoing use of the facilities. This could be done through systematic
site observations, surveys and interviews and lead to identification of user groups and behavior patterns on site. In this way, the suggested design strategy can be validated, and it can be determined how the suggested model can assist architects to meet the intended visions and attract the intended user groups (Hjort et al., 2018).

Due to the prevalence of physical inactivity with negative trends especially in the developed countries, attention is drawn on how we can promote health-enhancing physical activity. Architects have a very important role in creating supportive built environments with healthy options. This involves building appealing facilities for sport and recreation, but it requires the profession to be more ambitious and involve interdisciplinary knowledge in the planning process. New teaching principles at architectural universities could push the profession into the direction of more interdisciplinarity and transparency in the design process (Zambelli et al., 2008).

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Further reading


About the authors

Mikkel Hjort has been PhD Student since 2015 in the Active Living Research Unit, Department of Sports Science and Clinical Biomechanics at the University of Southern Denmark. He is trained landscape Architect graduated from the Royal Veterinary and Agricultural University, Department of Landscape, Frederiksberg in 2006. Between 2006 and 2015, he worked as Landscape Architect with special focus on sport and recreational facilities. Mikkel Hjort is the corresponding author and can be contacted at: mjhjort@health.sdu.dk
W. Mike Martin is Professor Emeritus of Architecture in the Architecture Department, College of Environmental Design, University of California – Berkeley. He is Fellow of the American Institute of Architects and a recipient of the 2005 AIA College of Fellows Latrobe Fellowship for Research. He received the 2010 AIACC Honor in Education award. He served as President Elect of the San Francisco Chapter of the AIA. He also served as Editor of Architecture California (AIACC).

Jens Troelsen is Professor and Head of Active Living Research Unit, Department of Sports Science and Clinical Biomechanics at the University of Southern Denmark. He has authored scientific papers, books and reports on the significance of landscape and urban planning for physical activity behavior. In recent years, his research has focused on conditions required to integrate physical activity into everyday life with the objective of obtaining evidence-based knowledge about how the built and natural environment combined with individual and organizational initiatives can promote active living.