How Smart Materials Can Help Occupants To Live In More Sustainable Buildings

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ABSTRACT- ***"Smart materials" is a collective definition applying to any technologies and materials that operate with a smart behavior. At this area new knowledge-based tenets and material characteristics can be discovered. Smart materials are widely considered as having vast potential to deliver advantages to many fields of research and implementation and are attracting growing investments from businesses and governments in every place of the world. Simultaneously, it is identified that its usage may cause new challenges in the security, regulation or ethical public domains that will require social discussion. Against this backdrop the question raises in importance on how Smart materials can be improved in a sustainable way over the entire life cycle. This particular issue concentrates on distinctive aspects of sustainable Smart materials development. It reveals the advancement that has been made in this area and emphasizes important achievements and disparities in theoretical as well at applied levels.***

Keywords: Smart materials; Sustainable development; Life cycle perspective

1. INTRODUCTION

There is broad unanimity that achieving sustainability is our prevalent human target, but there are numerous viable ways that must be integrated with each others to get there. The many distinctive areas to work with sustainability ambiguities are as well reflected in an increasing amount of research (see e.g. [3,5]). Sustainability has been reflected with respect to how energy policies have an effect on the social, economical and environmental purposes of various countries, how business performances can be run lucratively with a pollution diminution focus, how product progression can combine aspects of sustainability, how refocusing to a product-application can enable the introduction of further sustainable ways, how consuming properly is alpha and omega for sustainability and how basically essential community work and education are to begin addressing the challenge. The intention of this particular Issue is to reflect on how the growth and development of Smart materials may contribute to sustainable development. Smart materials, actually, a concept for newly developed materials and technologies working with transient behaviors and interactive response to their environment, are considered enabling materials and technologies for a wide variety of traditional and modern scientific disciplines. This has led to great expectations that Smart materials will be key materials and technologies for enhancing peoples' standard of lifestyle, in a short-term by considerably enhancing current procedures and products and in the long-term by supplying innovative and life-changing progresses across a various kinds of industries from smart colors, lightweight materials to renewable energy. The innovative characteristics that make Smart materials so fascinating have also raised many unanswered questions and concerns connected to the effects, negative and positive, Smart materials may have on the society and the environment from the viewpoint of sustainability. The development of new technologies is customarily taught in universities outside the social and environmental system context. However, the connections between technology growth and sustainability are seen as indisputable, and varied methods and schools of thinking have been developed to evaluate and manage these connections (see e.g. [9,10]). Sustainable technologies are, in our opinion, described by huge advantages, low risks for the short- and long-term and social approval. It is essential to distinguish that technologies are not created in a vacuum, but appear from the interaction with a wide constellation of social activities and actors [1]. Technologies are therefore, in fact, a product of social systems. This is also why technology growth has to be deeply embedded within united risk management approaches and life cycle thoughts. However, united risk management is a challenging task. The concept of risk comprises, besides the conventional criteria of possibility of incident and extent of damage, also the criteria of uncertainty, ubiquity, continuity, reversibility, delay impacts and potential of mobilization [4]. Therefore, with the aim of creating more firm decisions it is essential to work closely with stakeholders and other involved groups such as experts in industry or academia, technology measurement specialists, company managers, politicians and investors [2,7]. They can contribute greatly in connection with their practical

knowledge and notions of worthwhile solutions. Besides the approval of technologies by their respective communities, involvement of stakeholders and intensive discussions of advantages and risks also makes more advanced planning possible. The technology also needs to be evaluated by its full life cycle torrent of material and energy in the systems of production and consumption, thus preventing future environmental problems [8, 10]. This suggests a ‘‘highly developed’’ approach as they are ‘‘protective and preventive’’ strategies to protect life on earth. Through the deliberation of natural resources and human systems together, procedures to lessen the utilization of raw materials and energy, and to impede or diminish the production of waste, can increase efficiency and bring monetary profits to enterprises.

2. AN OVERWIEW OF SMART MATERIALS

The innovative use of newly developed materials and technologies has historically been a driving force behind the development of new architectural ideas and forms. In our modern era, architects are fortunate to have access to a wide variety of materials that exhibit many interesting properties or characteristics that can be potentially utilized in the creation of new forms. These include "smart materials" that exhibit transient behaviors when their environments vary, or have properties that can otherwise be made responsive to changing needs. Photochromic materials, for example, change their color when exposed to varying light intensities, while a change in temperature causes a change in color in thermochromic materials. Many smart materials exhibit electroluminescent behaviors when the source of excitation is an applied voltage or electric field. Shape memory alloys exhibit a remarkable ability -- these materials can shaped into one configuration at a high temperature, deformed dramatically while at a lower temperature, and then revert back to their original configuration upon the application of heat in any form, including an electrical current. Shape memory polymers exhibit similar capabilities. Other newly developed materials include a whole range of different types of materials whose transparencies can be varied to suit different architectural needs, e.g., suspended particle displays. These and other materials exhibit so-called "smart" behaviors.[6]

These newly developed materials and technologies offer an architect exciting new possibilities for making new forms of buildings that are responsive to their surrounding environments and user needs. Many of these materials and technologies are already in widespread use in the product design sector, e.g., photochromics and thermochromics, and are rapidly finding their way into architecture. Others, however, remain in the early stage of development and their applicability to architectural needs is either unclear or problematic. Shape memory alloys, for example, are exciting but currently exist only in very small dimensions suitable more for products rather than buildings. With many smart materials, actual applications in an architectural setting remain largely unexplored. Perhaps this is one reason why the field is so exciting at the moment. This paper is an initial exploration of how smart materials might be used in architecture with sustainable approach, but by no means answers all questions. It seeks to bridge the gap between the world of sustainability and application of newly developed materials in architecture.

3. THE OBJECTIVES AND THE ROLE OF SMART MATERIALS IN SUSTAINABLE BUILDINGS

Smart and Sustainable buildings characterize good exercise in scheming, planning and building buildings to make them more publicly, environmentally and profitably sustainable. This chart is a summary of the tenets and goals that are itemized in— applying to this chart for the necessities to attain each criterion. If the majority of the objects below are met, the building will be more probable to meet the changing requirements of the settlers, as well as make it a more sustainable, protected, secure, efficient and environmentally friendly residence in which to live. A minimum of 80% of the crucial criteria need to be met to attain the necessities of the Design Objectives. There is also scope to supply an alternative to the necessities outlined in the Design Objectives.

		Environment				Social						Economic						
Criteria	Objective	Energy	Water	Materials and Waste	Site Impact	Hman Comfort	Human Health	Safety	Security	Universal Design	Sense Of Community	Initial Costs	Maintenance Costs	Running Costs	Future Modifications	Community Costs	Achieved	Alternative
Site and landscape	Relates to site selection, landscaping, planting and pest protection																	
Objective 1	Site conditions are assessed for a passively designed home to be constructed	▨					▨							▨				
Objective 2	The loss of biodiversity is minimised				▨													
Objective 3	Soil degradation (and need for fertilisers), sediment run off and storm water runoff has been reduced				▨		▨									▨		
Objective 4	Landscaping reduces need for water, chemical and energy inputs	▨	▨		▨		▨							▨				
Objective 5	Creating a secure home and neighbourhood								▨		▨					▨		
Objective 6	Consider all natural hazards				▨			▨								▨		
Dwelling access	Access by owners, visitors, emergency services and prevention of uninvited access																	
Objective 1	Access to the main entry of the home from the street is easy for all occupants and visitors							▨		▨					▨			
Objective 2	The risk of children being run over by vehicles is minimised							▨								▨		
Objective 3	The home is secured from illegal entry								▨					▨		▨		
General dwelling design	Relates to overall design, safety, access, storage, passive design, etc																	
Objective 1	People can quickly leave the home in the case of an emergency							▨										
Objective 2	The risk of a child falling from a window is minimised							▨										
Objective 3	Movement through the home is easy and safe for people of all ages and abilities							▨		▨					▨			
Objective 4	The risk of injuries on stairs is reduced							▨		▨								
Objective 5	The dwelling facilitates indoor and outdoor living	▨					▨											
Objective 6	Balconies are designed to be safe for children							▨										
Objective 7	There is adequate storage space							▨		▨					▨	▨		
Objective 8	Reduce energy consumption for drying clothes	▨												▨				
Objective 9	People of all ages and abilities can easily and safely open and close doors, cupboards and drawers							▨		▨					▨			
Objective 10	Injury from sharp corners is minimised							▨		▨								
General dwelling design	Relates to overall design, safety, access, storage, passive design, etc																	
Objective 1	People can quickly leave the home in the case of an emergency							▨										
Objective 2	The risk of a child falling from a window is minimised							▨										
Objective 3	Movement through the home is easy and safe for people of all ages and abilities							▨		▨					▨			
Objective 4	The risk of injuries on stairs is reduced							▨		▨								
Objective 5	The dwelling facilitates indoor and outdoor living	▨					▨											
Objective 6	Balconies are designed to be safe for children							▨										
Objective 7	There is adequate storage space							▨		▨					▨	▨		
Objective 8	Reduce energy consumption for drying clothes	▨												▨				
Objective 9	People of all ages and abilities can easily and safely open and close doors, cupboards and drawers							▨		▨					▨			
Objective 10	Injury from sharp corners is minimised							▨		▨								

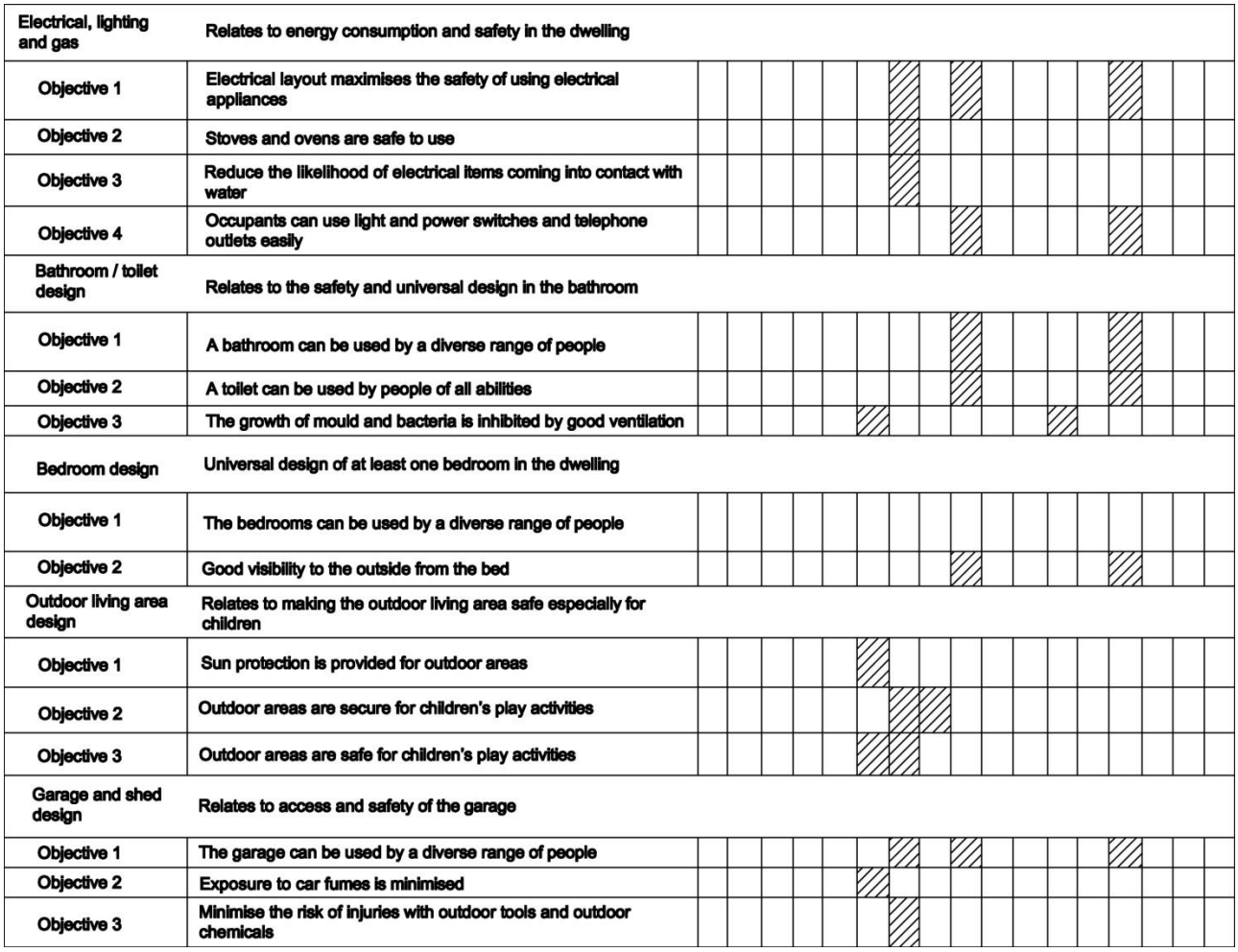

Figure 1. The role of smart materials in optimization in smart building

3. CONCLUSION

We believe that the papers in this Special Issue will be of interest and relevance to a broad range of readers. We can draw from this issue that the research of the link between sustainability and Smart materials is still quite in the beginning, but we also see that it is a topic of increasing attention. Based on this collection of papers we find that in order to develop Smart materials within the context of sustainability, the following main challenges have to be addressed:

_ The database on life cycle implications has to be extended. In addition to academic research, industries will have to extend their contribution of information to decision makers and other stakeholders.

_ Options should be investigated where Smart materials can play a key role in substituting other polluting or hazardous technological options.

_ Develop policies for Smart materials either by regulatory based or by industrial self-regulatory that includes industrial commitment to research the potential impacts of their technology.

A major element of the effort to promote sustainability in technology development will be the exploration and organization of mediating processes between different actors. Many analysts agree that sustainability will remain a highly desirable, but unrealistic, option for development if people do not feel a degree of ownership and identity with the goal of sustainability and a preference for its policy implications. Many targets of sustainability require voluntary collective actions by different players in society, most notably industry, government, unions, and environmental groups. As long as they paralyze each other, nothing will be gained with respect to a more sustainable economic path. We hope that this Special Issue will foster dialogues between different stakeholders, but also provide ideas and opportunities for different research disciplines to combine their strengths while pursuing their research of Smart materials in light of sustainability.

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