

Northumbria University Faculty of Engineering and Environment PhD –Department of Architecture and Built Environment

### IDRiM Virtual Workshop

**Living-Transforming Post-disaster Accommodation:** Towards a Long-term Housing Conceptual Approach that Extends Beyond Sustainability

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#### Supervisors:

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#### LTFDR-SHELTER (Interdisciplinary approach)



#### The main aim of this research is to investigate the application of 'Living-Transforming Post-Disaster shelter' conceptual approach as a way of providing post-disaster housing effectively

#### **Objectives:**

- Analyze the existing approaches for post-disaster housing and clarify the proposed 'Transforming Post-Disaster shelter' conceptual approach
- Review the potential opportunities and challenges of new Engineered Living Materials (ELM) to explore their effective applicability in the built environment.
- Evaluate the applicability of new engineered living materials (ELM) in 'Transforming DR-shelter' conceptual approach
- Determine the concept of 'Living-Transforming DR-shelter' approach
- Develop the 'Living-Transforming DR-shelter' framework of critical success factor (CSFs), challenges and opportunities

# Proactive approach Making with life Values Needs Ethics Risks







(Fengler, Ihsan, & Kaiser, 2008)

#### **LTFDR-SHELTER- Comparison to existing approaches**





3-phased approach

Transitional Add value to next phase





Living-Transforming Transform value to better quality for next phase



#### **POST-DISATER SHELTER PROVISION AND RECONSTRUCTION APPROACHES**





Living-Transforming DR Shelter Approach 📕 🛃 👘 🖌 🕪 🖉 🖬 🖉 🔤 00 .... ∞ + 🕅 = 🖂 ++ 🖂



#### LTFDR-SHELTER- "Resource Efficiency" from new methods of bio-production on site



#### **Comparison of resource efficiency in existing DR-shelter approaches**



#### **CHARACTERISTICS OF TS-Shelters approach- Resource efficiency** (How it adds value to next Phase)





Towards more sustainability

#### **LTF SHELTER**



Add value from phase to phase Dependency on external help





**Transform** into a **better value Less dependant on external** help By resource **manufacture on site** 



#### LTF SHELTER-LIFESPAN-TIME- CHANGE- QUALITY- (Increase Quality to increase Permanency)





Living-Transforming Transform value to better quality for next phase







#### LTFDR-SHELTER - Comparison to existing approaches to Resource efficiency



3-phased approach



Transitional Add value to next phase





Living-Transforming Transform value to better quality for next phase



#### **Bio-design Categories**



DESIGN 00001

DESIGN 00003









DESIGN 01001

DESIGN 01002

DESIGN 01003











**DESIGN 02004** 

DESIGN 01004

DESIGN 02001

DESIGN 02003 DESIGN 02002









(Yao 2017)



EXAMPLES:	bio-utilization	bio assisted	biomimicry
	exa	ample 1: abalone nacre	
well- adapted	sustainable harvest of wild abalone for nacre	natural breeding of abalone for farming	mimicry of nacre self- assembly processes
mal- adapted	over-harvesting of wild abalone for nacre	genetic engineering of abalone to create "better" nacre	producing high-tech ceramics using heat, beat, and treat
	exam	ole 2: spider/silkworm silk	
well- adapted	sustainable harvest of silkworm silk	natural breeding to maximize silk production	mimicry of spider's manufacturing process
mal- adapted	over-harvesting of silkworm silk	bio-engineering goats to produce silk proteins in milk	nylon and kevlar manufacturing

(Baumeister, Tocke et al. 2012)



Biologic, touch sensitive plants

Baloyc.

responsive

lamoshade



PneUI shape changing phon



**Engineered Living Materials** 

## Engineered Living Materials

- Rational Genetic Modifications
- Multicellular Hierarchies
- Prescribed Morphologies
- Biopolymer Production



- Cell as a Biofactory
- Extend survivability
- Optimize metabolic performance
- Sense environment dynamically

- Self-healing building materials
- Living fabrics that sense biometrics
- Bioplastics with
- triggered degradation

#### **Engineered Living Materials**



#### **Engineered Living Materials**

Hub for Biotechnology in the Built Environment Factsheet



#### LIVING TECHNOLOGY AS AN ASSISTANCE METHOD

Diagram 18 assistance methods





#### LTFDR-SHELTER (Beyond Sustainable VS Environmental Sustainability)



**Natural Environment** 



## Energy and Information flow Share Resources





architecture



**Built Environment** 

(Armstrong, 2010)

#### **TIME - PROCESS**

Conventional Multi-phased unsustainable approach without long-term Performance Consideration

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**Transitional Shelter Approach** 



Living-Transforming Shelter Approach





#### **RESOURCES /COST – CASH DISTRIBUTION AND VALUE**

Conventional Multi-phased unsustainable approach without long-term Performance Consideration

**Transitional Shelter Approach** 

Living-Transforming DR Shelter Approach



#### **RESOURCES, MATERIAL DISTRIBUTION**

Conventional Multi-phased unsustainable approach without long-term Performance Consideration

**Transitional Shelter Approach** 

Living-Transforming Shelter Approach



#### To **WHAT** TS characteristic and **HOW** each LTF characteristic can contribute through what **Strategy**



#### LTF ADAPTABILITY in terms of Insulation against: Rain, Wind, Coldness, Dampness in different climates



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Baumeister, D., Tocke, R., Dwyer, J., Ritter, S., & Benyus, J. (2013). Biomimicry resource handbook: A seed bank of knowledge and best practices. In: Missoula, MT, USA: Biomimicry.

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# Thank You

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