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Adaptive Architecture Society and Its productiveeconomy

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Abstract: Adaptive architecture in society means how well our communities can change and adjust to different situations. This research looks at how this ability affects how well our economy works. We've found that when societies can adapt easily, they can handle problems better and come up with new ideas faster. This is important because it helps economies grow and be more efficient. By being flexible and able to change, societies can deal with the challenges like climate change and new technology. This research shows that when everyone works together to make their society more adaptable, it leads to better opportunities for everyone and a stronger economy overall.

Keywords **– adaptive architecture, society, economy, resilience, flexibility, innovation, challenges, climate change, technology, collaboration, opportunities, growth.**

I. INTRODUCTION

Adaptive Architecture is concerned with buildings that are designed to adapt to their environments, their inhabitants and objects as well as those buildings that are entirely driven by internal data. The term is an attempt to incorporate what people imply when they talk about flexible, interactive, responsive or indeed media architecture, the mounting interest in this emerging field being demonstrated by the large variety of recent publications, (Kroonenberg, 2007) (Harper, 2003) (Streitz et al., 1999).

Overall, Adaptive Architecture is not a well-defined field of architectural investigation. It ranges from designs for media facades to eco buildings, from responsive art installations to stage design and from artificial intelligence to ubiquitous computing, just to mention a few examples (Tscherteu, 2009, Roaf et al., 2007) (Bullivant, 2005) (Eng et al., 2003) (Rogers, 2006). As will be clear to anyone attending this conference, Adaptive Architecture brings together a number of different concerns stemming from a wide variety of disciplines, spanning Architecture, the Arts, Computer Science and Engineering among others. Whether buildings in this context are described as flexible, interactive or dynamic, they embrace the notion of Architecture being adaptive rather than being a static artefact, often with an emphasis on computer supported adaptation.

This conference contribution has the simple aim to explore the key elements of adaptive buildings with this aim in mind, the paper has case study and a description of their properties. it focuses on common properties of Adaptive Architecture, which are then illustrated with case studies. This is done by proposing a structure for discussion and categorization, which will be introduced below. In what follows, the term 'Adaptive Architecture' will be defined, before introducing the framework itself. This will be followed by a brief discussion of common design strategies that architects have access to when designing for adaptiveness.

II. DEFINITION OF ADAPTIVE ARCHITECTURE

All Architecture is adaptable on some level, as buildings can always be adapted 'manually' in some way. Brand's 'How Buildings learn' provides an insight into the different levels of adaptation to be expected and how these apply over different time scales (Brand, 1994). The use of the term 'Adaptive Architecture' must therefore be seen in this overall context and the following

delineates between adaptable and adaptive: Adaptive Architecture is concerned with buildings that are specifically designed to adapt (to their environment, to their inhabitants, to objects within them).

whether this is automatically or through human intervention. This can occur on multiple levels and frequently involves digital technology (sensors, actuators, controllers, communication technologies). Taking the above context into account, this definition and associated framework is therefore an attempt to incorporate a variety of approaches, such as those labelled flexible, interactive, responsive, smart, intelligent, cooperative, media, hybrid and mixed reality architecture (Kronenburg, 2007, Bullivant, 2005, Harper, 2003, Streitz et al., 1999, Zellner, 1999, Schnädelbach et al., 2007). All the above come with their own connotations and particular areas of focus. Adaptive Architecture as it is presented here, is structured to be independent of any of these particular concerns.

Before continuing with the body of the paper it is worth to set out one additional delineation. Although the term Adaptive Architecture is often used there, design processes themselves that are computationally adaptive to data drawn from the environment, inhabitants or relevant objects are not included in the framework. Recent approaches in generative design methods and data driven architecture highlight such adaptiveness during the design process. However, these do not necessarily in themselves lead to buildings that are adaptive during their occupied life cycle. However, they certainly do present a fascinating research field in themselves.

III. ADAPTIVE REUSE IN HERITAGE ARCHITECTURE

Conserving and Adapting Heritage architecture are generally placed into a large framework that not only considers the architectural aspects of the process but also the philosophical side that links our cultural values and identities. According to the modern philosophy of restoration developed in the 19th century by John Ruskin, there is a debate between the terminology of restoration and repair. To be more precise, "restoration" refers to the greatest amount of destruction a structure can endure, including destruction from which nothing can be recovered and destruction that is accompanied by a misleading description of the object that was destroyed Burman (1995). This stems from the idea that during the process of restoration, the original work is replaced by an exact replica and even though both pieces might look the same, the historic significance reduces as it is no longer the original creator's work but a copy. So, part of this debate is undoubtedly about 'value', existing value, past value, and future value in terms of historical and cultural identity. Viejo-Rose (2011). By the repair and conservation process and ensuring proper maintenance of the heritage site, we eliminate the need for restoration thereby keeping the value and identity intact.

The importance of adaptive reuse of Architecture heritage can be better understood by its impact on the various factors including cultural values, economy of the country and urban fabric of the surroundings. It can contribute to revitalization of urban fabric and strengthen the community's attachment to the property.

IV. THE ADAPTIVE BUILDING AND ITS COMPONENT

The pursuit of sustainable and resilient architecture, the concept of the adaptive building emerges as a beacon of innovation and efficiency. Unlike conventional structures, adaptive buildings are designed to respond dynamically to the evolving needs of occupants, environmental conditions, and technological advancements. At the heart of the adaptive building lie several key components that collectively contribute to its functionality and versatility.

4.1 Flexible spaces

One of the defining features of adaptive buildings is their ability to accommodate diverse functions and activities within a single space. Flexible floor plans, movable partitions, and modular furniture facilitate seamless transitions between different uses, allowing occupants to customize their environment according to their needs.

4.2 Responsive facades

For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE - 100 Index is taken from yahoo finance.

4.3 Intelligent system

Embedded within the infrastructure of adaptive buildings are advanced sensors, actuators, and control systems that enable autonomous operation and optimization. These intelligent systems monitor environmental parameters, occupancy patterns, and energy consumption, adjusting building settings and operations accordingly to maximize efficiency and sustainability.

4.4 Green infrastructure

Sustainable building practices are integral to the design and operation of adaptive buildings, with an emphasis on minimizing environmental impact and maximizing resource efficiency. Green roofs, rainwater harvesting systems, and permeable

pavements mitigate stormwater runoff and urban heat island effects, while indoor greenery and biophilic design elements promote occupant well-being and connection to nature.

4.5 Adaptive envelope

The envelope of an adaptive building encompasses its exterior walls, roof, and insulation, serving as a barrier between the interior and exterior environments. By employing innovative materials and construction techniques, adaptive envelopes can optimize thermal performance, acoustics, and air quality while minimizing heat loss, air leakage, and environmental impact.

4.6 Inhabitants

Architects might focus their design efforts on individual inhabitants of an adaptive building. Individuals might then be empowered to change architectural layout manually or the building might respond to them in a particular way automatically, for example drawing on personal data that might be available to the building about them. Bill Gates residence is a well-known exemplar case in this context, where a body worn personal tag is able to identify individuals and adjust temperature, music and lighting accordingly [James Cutler Architect's & Bohlin Cywinski Jackson, Bill Gates' House, Medina, Washington, USA]. Most buildings are not just occupied by a single individual however. Designing for adaptiveness for groups of individuals can be a real challenge in turn. Once again, an architect might concentrate on providing the possibilities for manual adaptations. Tose will then be negotiated amongst inhabitants. the automatic adaptation of buildings towards groups of individuals entails knowing something about their group behavior, probably learning over time and building up the necessary profiles. Technically, the complexity lies in aggregating from multiple streams of personal data and finding a way to aggregate those streams in a way that is meaningful and useful. the Adaptive House at the University of Colorado explored that space by taking in data from multiple inhabitants to allow the house to adapt a variety of parameters [Mozer, the Adaptive House, Boulder, [USA, 1997]. Finally, organizations with organization-wide motivations and strategies are a group of inhabitants that design for adaptiveness has to address. Organizational structures include those parts that manage the building facility overall, those parts that operate facilities on a daily basis (frequently 3rd party organizations) and the actual occupying organization, which might well be different from both the above. Adaptiveness needs to address their concerns with regards to keeping facilities responsive to organizational changes but also manageable on a day-to-day basis.

3.7 Environment

Adaptive Architecture can be designed to react to its exterior environment. As already highlighted, it is the societal motivation to live more sustainably that is a key driver in Adaptive Architecture at present. Adaptive elements are also designed to react to the interior environment, for example to ensure that temperatures inside are comfortable for inhabitants, but also to control the energy expenditure in achieving a particular comfort level. The previously introduced University of Nottingham research building does both as many technologically driven eco-projects would [Derek Trowell Architects, the BASF House, 2008, University of Nottingham, UK].

3.8 Objects

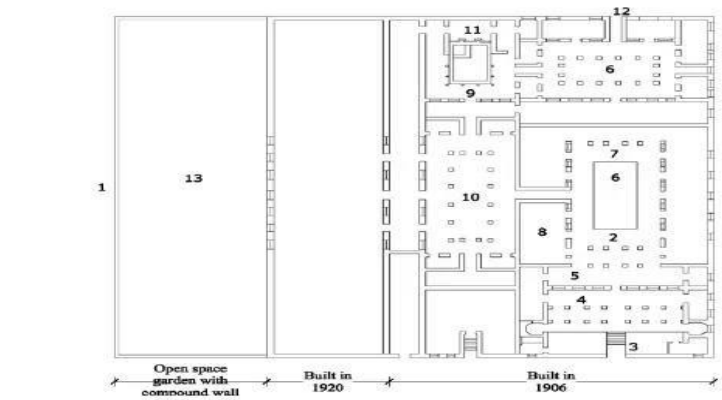
Adaptiveness in reaction to objects is comparatively much less common or at least less discussed. Buildings can be thought of that react to objects passing through. For example, a building might automatically restrict access to specific category of people when a specific, may be a particularly valuable, object is present. In a similar way, a warehouse might prepare the correct loading bay in anticipation of a particular delivery coming in. Objects within buildings can also play a more direct role in the process of adaptiveness in buildings. For example, at the in bate learning environment, a tangible interface object based on a color-coded cube allows the mixing of ambient color in the overall space [Sussex University, in bate, Sussex University, UK, 2007]. Finally, one might also think about adaptive architecture that adapts to objects passing by or overhead. Work within the Curious Home project at Goldsmith's college has explored a domestic device that visualizes the passing air traffic to give people living in the fight path near busy airport a handle on what goes on over their heads [Interaction Research Studio, Goldsmiths College, the Plane Tracker (the Curious Home), 2007]. Extending this idea, taking similar data streams, one could think of buildings that for example change their acoustic properties, when objects are passing that produce unwanted noise.[9].

IV. CASE STUDY

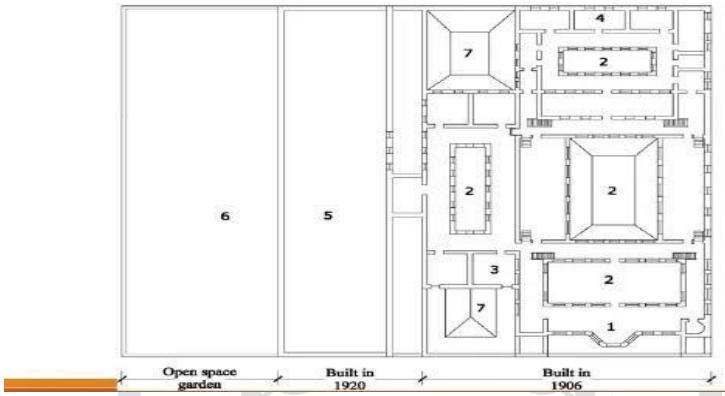
4.1 Introduction

Settlement pattern in Chettinadu follows a perfect urban grid and cultural components of caste. clan, kinship, joint family are manifested in the spatial organization of the Chettinadu houses.

Therefore, dwellings were palatial and identical in principles of planning but with variations in size, details and embellishment. The patter of settlement and design of mansions are sensitive to context connected with a complex network of rain water harvesting serving the entire village community. The houses all lie on an east-west axis, allowing shadows, coolness and breezes in. The walls are of brick and lime plaster and the roofs use terracotta, creating a cool internal micro climate.

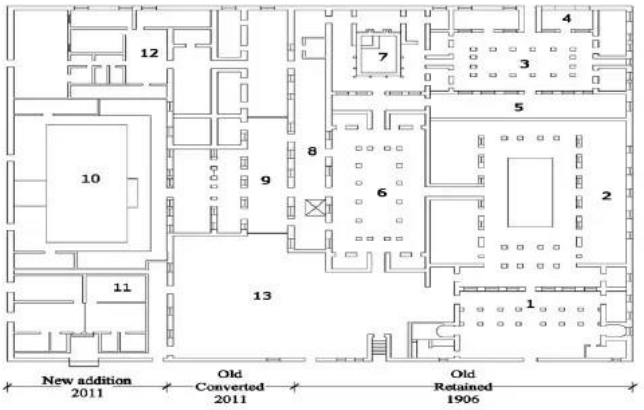


1	Madhil suveru
2	Nadai pathai
3	The keezh paththi
4	Kanakku pillai aria
5	Pattagasalai
6	'Valavu' erandam kattu
7	Suttru paththi
8	Arias or valavu veedu
9	Aduppadi or samayal arai
10	Bhojana hall
11	Pinpuram
12	Pinkadavu
13	Thottam

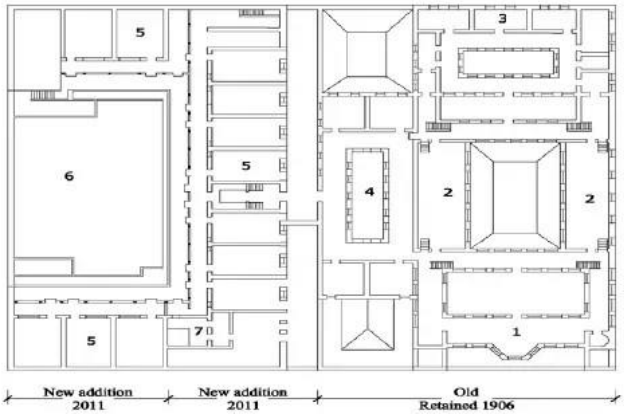


S.No	SPACES
1	Arai
2	Double storeyed hall
3	U I arai
4	Arai
5	Open terrace
6	Thottam
7	Slope roof

Image 4.1.1 before restoration plan



S.NO	SPACES
1	Reception office
2	Store room
3	Experimental kitchen
4	Rooms
5	Dinning hall
6	Restaurant
7	Modern kitchen
8	Service space
9	Recreation
10	Swimming pool
11	Ancillar facilities
12	Services
13	Owners residence



S.No	SPACES
1	Exhibition
2	Store
3	Store
4	Royal hall
5	Guest room
6	Swimming pool
7	House keeping

Image 4.1.2 after restoration plan

4.2 Design approach

The principle of construction in these mansions is columnar and trabeated, and the use of arches on the façade in later mansions comes as a result of the interface the Chettiars had with the colonial powers. The facades were elaborately embellished with solid void patterned parapets, motifs, finials, niches with stucco sculptures of Hindu Gods and Goddesses, British benefactors, flora, fauna, mythical creations, geometric patterns, etc., columns with capitals (wester Doric to Indian traditional), various types of arches, turrets, and a color scheme using terracotta, white, yellow, red and blue. This established a unique architectural character which can be termed as the Chettinadu style.

4.3 External treatment

The mansion are characterized by exquisite wood work seen in the doorways and in the columns and brackets that surround the courtyards using Burma teak, rose wood and stain wood. Most attention is given to the threshold with highly carved and decorated jambs, lintel, panels. The expanded lintel panel above the main door depicts various iconographic from Hindu mythology. Walls were of baked bricks laid by skilled masons and covered chettinadu plaster and flooring was provided with local aathangudi tiles peculiar only to this region.

4.4 Interior

Interiors are embellished with Chinese ceramic and local tiles, imported Italian marble.
Belgian glasswork, stoneware and ironware. Study reveals that adaptive reuse has been carried out with due respect to the ideologies of this traditional dwelling with minimal intervention. Two types of spatial usage pattern have been identified. The first type is assigning similar usage to the original use of the space and second type, is assigning different usage for the space but with minimum intervention like closing the doorways, adding a partition wall, providing lighting fixtures etc.

S.NO	ORIGINAL SPACES	ORIGINAL USE	PRESENT USE
1	Mathil suveru - compound wall	Security	Height increased and used as gallery to exhibit culture of Chettinadu.
2.	Munpuram – front open space	With kinaru (well) and related bathing and washing activities of men.	Kinaru retained as a cultural artifact
3.	Thinnai – raised platform with columns	Greeting and entertaining male guests	receiving guests
4.	kannakkupillai arai - accountant's room	Office room of the family's male accountant (Fig.3)	Hotel's office and accounts room (Fig.3)
5.	Pattagasalai - men's greeting room	For business discussion	Display area of Chettinadu artifacts
6	valavu - single central courtyard	Conducting religious festivals and ceremonies	Demonstration of the traditional activities during the festivals times to experience.
7.	Arais - rooms	Sleeping , storing valuables and other grocery	Store
8.	Pendir arai – women's room	Exclusive women's room for sleeping and other activities	Dining hall for guests
9.	Kottagai – double storeyed hall	Conducting life cycle ceremonies	Exhibition space of paintings and experimental kitchen.
10.	bhojana hall (dining hall)	Dining for guests	restaurant
11.	Samyal arai - kitchen	Cooking using traditional choola (open hearth)	Cooking with modern gadgets
12	Suttrupathi - Corridor	Sleeping, relaxing	For circulation and accommodating modern services
13.	Thottam - garden	Cattle sheds and garden	Swimming pool and ancillary facilities

Image 4.1.3 original use and present use of space table

4.5 Inference

The restoration of the mansion is done in line with ethos of conservation. The architectural character of the facade done in two different times blends projecting one entity. The three-year-old extension uses materials, finishes and details similar to that of the 110-year-oldmansion and the difference between the two cannot be discemed unless subjected to minute scrutiny. The new functions for the old spaces give due respect to the traditional usage of space.
The newly created spaces and the moder amenities are incorporated with great sensitivity to the old structure as well as to the historic fabric. The conservation practices and restoration techniques applied in this heritage hotel can be taken as a model for other similar projects in the district where these mansions are in abundance and will therefore enable sustainable conservation practice.[8].

V. CONCLUSION

The adaptive architecture of society and its correlation with a productive economy underscore a symbiotic relationship crucial for sustainable development and resilience in the face of contemporary challenges. Through an in-depth exploration of various facets of adaptive architecture, including technological advancements, socio-cultural dynamics, and institutional frameworks, this research paper has illuminated the multifaceted nature of societal adaptation and its profound implications for economic productivity.

In conclusion, it is evident that adaptive architecture in society serves as a catalyst for fostering innovation, enhancing efficiency, and promoting inclusivity within economic systems. By embracing flexibility, diversity, and responsiveness, societies can better navigate complex socio-economic landscapes, anticipate disruptions, and capitalize on emerging opportunities. Furthermore, fostering a conducive environment for adaptive architecture requires collaborative efforts from policymakers, businesses, communities, and individuals to cultivate resilience, promote sustainable practices, and ensure equitable access to resources and opportunities.

As we continue to grapple with global challenges such as climate change, technological disruptions, and socio-political upheavals, the significance of adaptive architecture in shaping a productive economy cannot be overstated. Embracing adaptability

as a guiding principle offers a pathway towards building more robust, dynamic, and inclusive societies capable of thriving in an ever-evolving world. Thus, this research underscores the imperative of prioritizing adaptive architecture as a cornerstone of socio-economic development strategies, with the potential to unlock new avenues for growth, prosperity, and human flourishing in the 21st century and beyond.

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