Flexibility as a design aspiration: the facilities management perspective

Flexibilidade como aspiração do projeto: a perspective da gestão de facilities

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Abstract

The concept of flexibility as a design aspiration is often discussed in architectural literature. However, it is invariably the facilities management profession that inherits the building solution: it is these professionals who incur the consequences of inflexible or flexible solutions. In this respect, buildings are not a one-shot process, but an evolving solution. A flexible building design is one that can adapt in response to changing circumstances. However, the dilemma for the designer is in anticipating likely changes. As such, the designer acquires the role of futurologist; "technological forecaster" or foresight analyst. The purpose of this paper is to present the facilities management perspective of flexibility. It indicates how designers can assist in producing a more pliable design solution. It suggests that the concept of universal flexibility is both technically and economically unachievable. Design for flexibility requires an understanding of multiple future states, both possible and probable.

Keywords: Flexibility. Organizational transformation. Organization development. Design awards. Occupier engagement.

Resumo

O conceito de flexibilidade como aspiração de projeto é discutido com freqüência na literatura sobre Arquitetura. No entanto, é invariavelmente os profissionais de gestão de facilities que herdam a solução da edificação: estes são os que acabam sofrendo as conseqüências das soluções flexíveis ou insolúveis. Neste sentido, os edifícios não são soluções acabadas, mas em desenvolvimento. Um projeto de edificação flexível de é aquele que pode se adaptar a situações que se alteram. No entanto, o dilema do projetista é antecipar-se às prováveis mudanças. Como tal, o projetista assume o papel de futurólogo", "vidente tecnológico" ou analista de mega-tendências. O objetivo deste artigo é apresentar a perspectiva de flexibilidade da gestão de facilities. Sugere-se como os projetistas podem ajudar a produzir uma solução de projeto mais "maleável" e que o conceito de flexibilidade universal é técnica e economicamente inatingível. Projetar para a flexibilidade requer o conhecimento de múltiplos estados futuros, tanto os possíveis, como os prováveis.

Palavras-chave: Flexibilidade. Transformação organizacional. Desenvolvimento das organizações. Premiação de projetos. Engajamento do usuário.

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Introdução

The realisation of building design quality is not a 'one-shot' process: it is an 'emergent' feature which continues throughout the operational phase of the building (VISCHER, 1989; WORTHINGTON, 2001). This fact is consistently overlooked in national and international architectural design awards which focus on the building 'as new' and which underplay the 'emergent' nature of building solutions. The purpose of this paper is to explore the practical significance of 'flexibility' as a concept. It argues that the term is a multifaceted concept founded on an informed view of the future. Flexibility as a concept is both contingent and contextual. The article concludes by presenting a 'flexibility' model (adapted from Mintzberg and Westley) which explicitly recognises the role of facilities and building design in the change management process.

Currently, flexibility is achieved through over-specification with respect to mechanical and electrical plant sizing, floor area provision and floor loading amongst other examples. The consequence of such overprovision is reduced efficiencies of plant, high occupancy costs and unnecessary maintenance. For many commercial mission- critical facilities this is seen as a price worth paying. The cost of disruption caused by intractable design limitations (e.g. insufficient cooling load) quickly offset the added cost burden of overcapacity. But in a world of environmental responsibility, this approach to flexibility presents a dilemma – simply 'building for growth' is both costly and unimaginative. In the era of sustainable design, facilities managers are looking for more ingenious approaches to flexibility: approaches that more reliably reflect the future demands of buildings. 'Change readiness' is impacting on design solutions in a fundamental way. In order to make sense of this, a framework is proposed for dealing with flexibility in building design based on the original work of Mintzberg and Westley. Fundamentally, it recognises the 'emergent' nature of design solutions through their entire life. To achieve 'change-readiness' conceptual tools need to be developed to allow dialogue between facilities managers and architectural designers. These tools rely on a 'layered' understanding of the design solution space. Exploration of such solutions depends on an approach that connects the conceptual level and the concrete level of organisational transformation.

Building design and flexibility

Flexibility has become an overriding concern for organisations functioning in a turbulent business environment. Commercial office space has often failed to keep apace with the demand for rapid organisational change. Indeed, the ownership of real estate and the prevalence of long lease periods are often seen as impediments to organisational change (HARRIS, 2001; LATSHAW; HARMON-VAUGHAN; RADFORD, 2001). Likewise, adaptable solutions in the healthcare sector are now seen as essential in the face of new technology and new clinical techniques (BOURNE JUNIOR, 2004). Examples in this context include the use of interstitial (service) floors; modular laboratory and process area layouts; and service corridors. The effect of these innovations is that changes can be made in one space without affecting the day to day operation of the surrounding areas. The service corridors also allow personnel to make operational changes such as filter replacements, repairs and transfer of equipment, without entering into laboratory space itself. This addresses issues such as noise, hygiene and code compliance for accessibility.

In the educational sector, recognition of the importance of flexibility was outlined as early as 1968 (GROSS; MURPHY, 1968) in a report by the American Educational Facilities Laboratories. Four distinctive subcategories of flexibility were identified in this context:

(a) expansible space: which can allow for ordered growth. The use of structural steel frames with long steel joists and the elimination of internal structural walls are cited by Rydeen (2004) as key developments in this context;

(b) convertible space: which can be economically adapted to program changes. The adoption of relocatable partitions as part of the School Construction Systems Development (SCSD) between 1966 and 1977 in more than 1300 US schools illustrates a measure used to meet this challenge;

(c) versatile space: which serves multiple functions. Rydeen (2004) cites as an example the 'house concept' using a central open learning area tech-hub surrounded by classrooms; and

(d) malleable space: which can be changed "at once and at will." Rydeen (2004) suggests that *open learning environments* help to meet this challenge by supporting variable class sizes.

Lessons from the office sector

One way of deconstructing building design decisions is to use the layered model developed by DEGW (MYERSON *et al*, 1997) see Table 1 which was originally conceived for use in the office sector. Using this layered approach to design decision making highlights the 'emergent' nature of buildings, comprised of life-cycles within life-cycles. The analogy here is that of the human body: whilst the human body itself may have an expected life beyond seventy years, organs such as the human skin may replenish themselves several times over during that lifetime. The significance of this model is that design decisions may be more or less intractable. For example, the site is fixed and building shells cannot be easily modified during the lifetime of a building. Thus, for the client, any long-term commitment to the building must involve careful consideration of the constraining factors imposed by the building shell. Contrariwise, scenery, systems and settings should be capable of being routinely altered to accommodate changing client requirements.

Given this understanding of how buildings can be deconstructed, how does this help with an evaluation of existing buildings in relation to flexibility? A unique study by Bottom, McGreal and Heaney (1998) involved the use of a 'supply and demand' model as part of a post occupancy evaluation (POE) questionnaire to collect tenant's perceptions of specific building design/quality factors. The analysis involved 39 design/quality factors. This questionnaire instrument was used in conjunction with an expert-based survey instrument to collect information about the physical characteristics of each building. The buildings of interest in the study were the investment class office buildings and tenant organisations in the City of London. A total of 40 buildings were considered in total with tenant units of between 1,000 and 5,000m^2 net internal floor area. The results from the study highlighted the central significance of flexibility as a design issue.

The findings relating to the relationship between supply and demand in relation to building shell are revealing. If the supply in buildings considered in the survey matched the demand one would expect the rankings to be equal for a given factor. The equal rankings would reflect a consistent prioritisation of relevant quality factors (either low priority or high priority). Where there is a considerable divergence in ranking score it suggests that the existing market does not accurately reflect the current demand. As shown in Table 2 there is a considerable disparity between supply and demand. This is particularly apparent on factors that are associated with flexibility. Both floorspace flexibility and floor to ceiling height restrictions are flexibility factors: the former factor constraining the potential for varied use patterns (e.g. cellular or open plan space); the latter reflecting the limits on floor height impacting on the accommodation of IT and cabling. In the case of floor space flexibility, the demand for this factor (12th out of 39 factors) is considerably more important than that reflected in the availability of buildings meeting this demand (only scoring 27th out of 39 factors assessed in the expert building evaluations). A reversed mismatch applies to floor to ceiling height. The significance of this factor is ranked only 36th out of 39 factors, whilst the provision of existing space over-satisfies demand with a ranking of 7th out of all the factors. This mismatch may in part be explained by the development of fibre-optic communication cables which largely replaced twisted copper wiring during this time. Thus the overwhelming demand for increased floor depth arising from the accumulation of under-floor copper wiring was largely set-aside by the advent of more compact fibre-optic solutions.

A similar divergence between supply and demand was also apparent at the time of the study in relation to services (heating, cooling and power supply) as shown in Table 3. A significant mismatch is apparent between the *need* for 'increased control of users' (including heating, ventilation and lighting) and that *provided* by existing buildings. In the extreme case, the apparent quality gap between the supply (ranking at 36 out of 39 of all factors) and the demand (ranking seventh) for heating and cooling control indicate extreme problems of underperformance.

The above analysis shows how flexibility is often difficult to achieve in the context of changing occupant demands. It clearly demonstrates how attempts to achieve flexibility at the outset of building design are often destined to fail. New technologies emerge: expectations of knowledge workers increase and the priorities of organisations shift. The result is building solutions in which some aspects of design are subsequently over-specified (e.g. floor to ceiling heights) and others are underspecified (e.g. building controls). The lesson from this analysis is that flexibility to accommodate changing needs is problematic. Predicting the priorities of each need over time remains a challenge for designers, specifiers and users alike.

Building Element	Decision-making life cycle	Decision-making criteria
Site	Indefinite	
Shell	50-75 years	Shape, size and adaptability to organisational and technical changes
Skin	25 years	Aesthetics, integrity, energy efficiency
Services	10-15 years	Provision of cooling, heating, cabling and power capacity
Scenery	5- 7 years	Describes the internal elements such as ceilings and partitions Tailored to organisational needs
Systems	3 years	Adapted to meet organisational processes and products and involves accommodation of ICT (information and communication technology).
Settings	Day-to-day	Day to day arrangement of furniture and equipment

Table 1 - **DEGW layered model of building systems (based on Myerson *et al*, 1997)**

Factor	Supply Ranking	Demand Ranking
Flexibility of floorspace	27	12
Floor to ceiling heights	7	36
Quality of building exterior	8	15
Location of lifts, stairs and corridors	17	25

Table 2 - **Factors relating to building shell (based on Bottom *et al*, 1998)**

Factor	Supply Ranking	Demand Ranking
Heating and cooling control	36	7
Control of mechanical ventilation levels	37	14
Control of artificial lighting	28	18
Flexibility of power, IT, connection points	20	3
Stability of power supply to the building	5	1

Table 3 - **Factors relating to mechanical and electrical building services (based on Bottom *et al*, 1998)**

Flexibility of the real estate portfolio

The question of flexibility is clearly not confined to the design qualities of the building. The concept extends to the whole question of ownership. As observed by Gibson (2001, p.1), “Corporate real estate managers are faced with managing a resource which is inherently inflexible in a world which increasingly values flexibility as an essential attribute.”.

Gibson (2001) also argues that flexibility is a multidimensional concept, requiring different types of flexibility for different solutions. The paper suggests that real estate managers need to understand exactly what type of flexibility is required. It goes on to propose that flexibility has become increasingly important for three key reasons (GIBSON, 2001, p. 39):

(a) organizations have to operate in increasingly unpredictable environments which are changing rapidly. This in turn leads to shorter planning horizons;

(b) the practice of experimentation and the use of pilot projects is more commonplace amongst senior managers; and

(c) organizations are constantly reinventing themselves, with the adoption of ‘business process reengineering’ and the application of new technology.

The ‘flexibility’ model proposed by Gibson (2001) encompasses three distinct dimensions:

(a) physical flexibility;

(b) functional flexibility; and

(c) financial flexibility.

The first of these (physical) refers to the different ways in which internal space can be used – the variety of design options that are possible. The

second category (functional) describes the diversity of activities and functions a workspace can support. The final category (financial) considers the financial exposure and risk associated with the acquisition and ownership of a portfolio. The paper goes on to propose a portfolio decision making process that recognizes the degree of flexibility demanded by various oranisational activities. This is based on the distinction applied in human resource management between core and non-core business activities. It is suggested that the same distinction applied to the workforce can equally be applied to the real estate portfolio. Using this argument, core employees are typically employed on long-term contracts and are expected to be functionally flexible. As a result, such employees would typically demand higher pay and associated incentives. In contrast, non-core employees are typically employed on short-term or part-time contracts. Such employees are likely to brought in and out of the organization as a result of economic fluctuations and the need for particular skills.

Using exactly the same argument, real estate can be layered in a similar manner using what Gibson (2001) describes as the 'core-periphery' property portfolio model shown in Table 4.

This mixed approach to property portfolio management is increasingly evident in the market. Harris (2001) describes the dramatic changes in the UK property market with the demise of the 25 year lease based on a surety of income for institutional property investors. Replacing this has been a much more responsive, customer focused market initiated by recessionary periods in the 1980s and 1990s. This in turn has led to the need for delayering, downsizing, outsourcing and reengineering. Radically new models for corporate real estate ownership, including sale and leaseback, virtual communities, interactive facilities management as well as lifestyle support services all point towards a more flexible approach to portfolio management: one that unlocks the occupier from the constraints of long-leases and obsolete buildings.

Proposed flexibility model

This paper proposes a more granular analysis of flexibility compared to that of Gibson (2001). It is based on eleven distinct categories of 'flexibility'. These are based on categoires identified for the manufacturing industry by Browne, 1984; Sethi and Sethi, 1990 (see Table 5).

This typology is proposed as a means of providing:

(a) a richer vocabulary when dealing with the multifaceted nature of flexibility;

(b) allowing the more succinct measurement of flexibility in buildings; and

(c) exploring the diversity of future scenarios that need to be considered with a building design solution.

Whilst this typology provides a level of granular distinction between the various forms of flexibility, it does not identify the level at which design decisions impacts. The '*shell, set, scenery'* perspective of Myerson *et al* (1997) discussed previously does help to identify flexibility issues in relation to distinct time-horizons: however the layered model does not attempt to match this with specific strategic levels within an organization.

This paper presents a variation on the 'concentric cycles' of Mintzberg and Westley (1992) as a concise way of contextualizing flexibility issues in a form that is meaningful to organisations. It presents 'facilities' as sitting at the heart of any such decision model.

2nd Periphery Portfolio ➔	Required at short notice (pay as you go)
1st Periphery Portfolio ➔	Short lease with some services provided
Core layer ➔	Freehold/Long Lease with control of all aspects of service and ability to change use.

Table 4 – **Core-periphery model (adapted from Gibson, 2001)**

Workplace	Manufacture (Browne 1984)	Description of flexibility
Task flexibility	Machine flexibility	The different operation types that an individual user/machine can perform.
Circulation flexibility	Material handling flexibility	The ability to move the services/products within a facility.
Work style flexibility[2]	Operation flexibility	The ability to produce a solution/product in different ways.
Process flexibility[2]	Process flexibility	The set of services/products that the work environment/system can produce
Product flexibility[2]	Product flexibility	The ability to add new products or services in the system
Space configuration flexibility (physical flexibility[1])	Routing flexibility	The different routes (through machines and workshops) that can be used to produce a product in the system.
Churn flexibility	Volume flexibility	The ease to profitably increase or decrease the output of an existing system
Expansion flexibility	Expansion flexibility	The ability to build out the capacity of a building/system.
Building intelligence/automation flexibility	Program flexibility	The ability to run a system automatically.
Functional flexibility[2]	Production flexibility	The number of products a system currently can produce.
Portfolio adaptability[3]	Market flexibility	The ability of the system to adapt to market demands.

[1]Equivalent to *physical* flexibility as described by Gibson (2001)
[2]Equivalent to *functional* flexibility or some part of it as described by Gibson (2001)
[3]Equivalent to *financial* flexibility as described by Gibson (2001)

Table 5 - **A typology of building flexibility (adapted from Browne, 1984; Sethi and Sethi, 1990)**

Strategic layered model of flexible design issues

Flexibility as a concept is intimately linked to issues of change management in organizations. Mintzberg and Westley (1992) criticized much of current literature on change management. He argued that only 'trace elements are assembled into explanations'. He went on to argue that 'Whole processes get reduced to some disconnected dimension'. In response to this, Mintzberg and Westley (1992) attempted to depict the changes in organizations as a system of moving circles as a way of more accurately contextualizing change management initiatives in organizations. Each level within these concentric circles represented the various contents of organizational change, depicted at increasing levels of abstraction. Change management issues can be seen to affect different states in the organization from *people* at the concrete level, through systems and structure to culture at the more conceptual level as shown in Figure 1. This can also be seen to mirror the effect of flexibility on the various states of an organization.

As well as the *state* of an organization, Mintzberg and Westley (1992) also attempted to contextualize *strategic direction* at different levels in an organization. This is shown in Figure 2.

In this model, it is interesting to note the key part played by *facilities* sitting at the heart of the concentric circle for *direction*. This is succeeded

by *programs* (widespread changes), changes in *position* (personnel) and ultimately by *vision*. Of particular interest to Mintzberg and Westley (1992) is the interaction of these levels and contexts of state. He toyed with the question of whether changes of state must accompany each other. For example, can people be changed without changing facilities (and vice versa). He suggested that change processes can be logically stopped on their way up the scale but not down (e.g. going from *facilities* changes around the concentric circle, this does not necessarily have to be succeeded by *program* or *position* changes). He significantly argued that:

> *[. . .] the problem with many mergers and restructurings, as well as with strategic planning in general, is that they often tend to reconceive at a higher level without redoing at a lower one – following through with the consequential actions. (MINTZBERG; WESTLEY, 1992, p. 40).*

Using the initial constructs of Mintzberg and Westley, a framework for describing real estate flexibility is proposed as shown in Figure 3. This applies at the concrete level (where design quality decisions are made) relating to physical flexibility. This is then extended to the functional level, where flexibility issues relating to the nature and diversity of processes and activities that can be accommodated within an building design solution. Finally, at the level of financial flexibility, a much more strategic perspective is involved that relates to the vision and culture of the occupying organisation. However, as with the discussions by Mintzberg and Westley, the most interesting interactions occur between levels. Thus, the possibilities for changes to facilities afforded by physical flexibility, allow upward movement of change initiatives to the systems, structure and culture level.

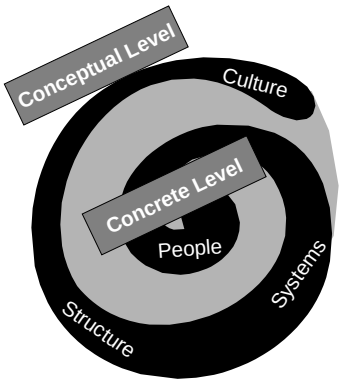

Figure 1 - **Levels of organisational change showing** *state* **(adapted from Mintzberg and Westley, 1992)**

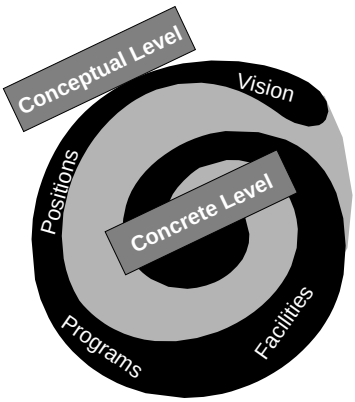

Figure 2 **- Organisational change showing** *strategic direction* **(adapted from Mintzberg and Westley, 1992)**

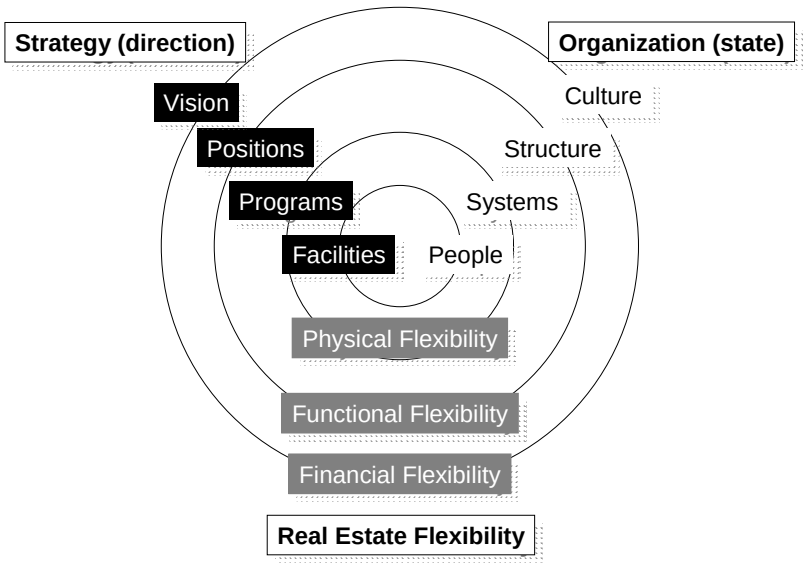

Figure 3 **- Contextualising 'flexibility' in relation to organizational change (adapted from Mintzberg and Westley, 1992)**

Conclusions

Current discussions on the subject of real-estate flexibility is often limited by the fragmented and non-contextualised definition of flexibility. In reality, it is a deeply multi-dimensional factor that links into organizational transformation at many different levels. In the current climate of dramatic organizational change, inflexible buildings are producing dysfunctional organizations. However, much of the problem stems from difficulties in articulating and predicting the various drivers that need to be considered in relation to flexibility. Excessive flexibility in the wrong dimension can lead to costly and inefficient building solutions that present a constant challenge for the incumbent facilities manager.

This discussion has attempted to articulate the numerous levels of flexibility, adopting a comprehensive ontology currently used in the manufacturing sector. It is envisaged that such a model opens the door to more sophisticated life-cycle costing and risk evaluation methods at the design stage. These methods need to explicitly recognize the multiple dimensions of flexibility at the physical, functional and financial level. Furthermore, such methods should more effectively capture the direct and indirect effects of improved flexibility at the various levels of organizational transformation. It is envisaged that further work by the author on this proposed 'flexibility model' will give rise to a contingent 'flexibility model' for the rating of buildings.

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