

MIXED-USE: WHAT IS IT?

JPG 1510 – Recent Debates on Urban Form Term Paper



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1. Planning Panacea?

For a variety of motivations, such as Toronto's desire to curb the number of daily trips (City of Toronto, 2006) or the U.K.'s interest in improving "urban diversity and vitality" (Hoppenbrouwer & Louw, 2005), mixed-use is now a principal component of most urban growth policies, inspired by contemporary planning paradigms such as Smart Growth, the Compact City, Sustainability, and New Urbanism. Despite its widespread adoption, theoretical analyses of the mixed-use concept remain scarce (Hoppenbrouwer & Louw, 2005). Moreover, little is known about what comprises an effective mix (Song & Knaap, 2004) or how desirable land use mixes can be achieved in existing or new developments. Details are glossed over, as nearly any mix of uses is embraced by planners eager to diversify the prevailing homogeneity of traditional suburban growth patterns. As such, mixed-use rhetoric is typically evoked as the antidote to sprawling urban form and the Euclidean zoning policies that encourage it.

Considering the historical context of nascent industrialization that single-use zoning policies arose from, they were justifiably aimed at separating smelly, noisy and polluting manufacturing operations from residential areas (Agnotti & Hanhardt, 2001). Simplistic and coarse separation of land uses, however, has also been blamed for a long list of problems. Rallying against urban renewal projects in New York, Jane Jacobs (1961) is largely credited for raising consciousness around the problems associated with single-use zoning and the benefits of mixing uses to promote street life (Agnotti & Hanhardt, 2001; Grant, 2002; Rowley, 1996). This discourse often harkens back to a nostalgia for urban form that pre-dates the twentieth century automobility. Although industrial operations have evolved considerably since the early 1920s, Agnotti & Hanhardt remind us to think critically about our simplistic nostalgia for these idealized memories of older mixed-use urban landscapes.

Workers and their families spent 12-14 hours six days a week toiling in factories. They slept in the shadows of their workplaces, inhaled the soot from smokestacks and drank water contaminated by factory wastes. This kind of 'integration' of workplace and residence can hardly be the objective of planners today. (Agnotti & Hanhardt, 2001, p. 148).

Mixed-use, as with many generalized urban planning visions, is more complex than may be immediately apparent. Hoppenbrouwer & Louw (2005) are weary of an overenthusiastic endorsement of mixed-use benefits, Rowley (1996) asserts it is not a panacea and Agnotti & Hanhardt (2001) emphasize that the devil is in the details. Even Jacobs' (1961) four "indispensable" criteria for generating a diverse street environment are not solely about mixing uses, although it is a key component. She makes it clear that all four must be present, thus, from the idea's inception, Jacobs also understood that mixed-use is only one piece in a complex urban pie.

"Mixed-use" is not something that a development either is or is not; all sites have some degree of land use mixing. We need to start thinking critically about defining particular types of mixing and their impacts; simply mixing uses is "not smart enough" (Song and Knaap, 2004, p. 677). For such a dissection, a theoretical framework is necessary. Some studies have opened this discussion, but the concept remains elusive and cluttered with jargon. In this paper I will not argue for the pros and cons of mixed-use, but rather how to better understand the idea and how others have interpreted it.

2. Defining Mixed-Use

"I worry that precisely because of the ambiguity of the term Mixed-use development, it will rapidly degenerate into just another marketing slogan for a product that is very pale imitation of the genuine article: this process has already started." (Rowley, 1996, p. 95)

The concept of mixed-use is frustratingly ambiguous (Agnotti & Hanhardt, 2001; Hoppenbrouwer & Louw, 2005; Rowley, 1996). Its definition is often assumed, yet there are many possible interpretations and some receive more attention than others. To some, mixed-use is simply a label certifying that a development meets a particular interpretation of what mixed-use projects should entail. The Urban Land Institute (ULI), for example, has a 400 page publication devoted to describing the development process involved in creating mixed-use projects (ULI, 1987). The publication is built around a peculiar definition requiring that a mixed-use development possess at least 3 revenue

producing uses, although they never explain who this revenue is for or why only such uses are considered relevant. As such, since cultural uses will “have difficulty paying their way” (ULI, 1987, p. 36), the institute suggests incorporating tourist entertainment attractions. The City of Toronto has a more liberal understanding of mixed-use that includes “a broad range of commercial, residential, and institutional uses, in single-use or mixed-use buildings, as well as parks and open spaces and utilities” (City of Toronto, 2006, p. 4-10), but again, the concept is treated as a distinct land use designation. Agnotti & Hanhardt present a wonderful list of questions that highlight the absurdity of simply labelling an area as “mixed-use” by showing the concept’s ambiguity around scale, time, culture, defining uses, and compatibility, among others (2001, pp. 146-147).

Some empirical studies have employed diverse interpretations of the term. Eid et al. (2006), for example, define mixed-use as the number of retail shops and churches in a neighbourhood. Frank & Pivo (1991) measure land-use mix using an entropy index, while Cervero (1996) criticizes policy based on the jobs-housing ratio (an indicator used by Song and Knaap, 2004). A handful of studies have devoted considerable attention to defining theoretical frameworks around the concept of mixing land uses before evaluating specific neighbourhood cases (for example, Agnotti & Handardt, 2001; Grant, 2002; Hoppenbrouwer & Louw, 2005; Rowley, 1996; Song & Knaap, 2004). Rowley (1996) was among the first, but his framework has several problems. Hoppenbrouwer & Louw (2005) expand on Rowley’s theory to develop a typology that adds clarity to some issues. Their typology is built around four aspects: urban function (land uses), dimension (vertical, horizontal, and time), urban scale, and urban texture. Although fairly comprehensive, unfortunately their study perpetuates some of Rowley’s ambiguous language: urban scale is redundant as it is also embodied in their spatial dimensions and urban texture is nothing more than a list of categories for different spatial distributions.

The following section is a reorganizing and clarification of the salient concepts surfacing in mixed-use literature. Mixed-use theory is reduced to three dimensions: space, time, and use. As this is primarily an extension of the Hoppenbrouwer & Louw study, the aim

is to help analyze mixed-use in a more systematic way to state with some precision what it is that various academics and city policies envision when they speak of mixed-use. Perhaps more importantly, this framework helps to identify the gaps in our understanding of mixing land uses to help direct future research and policy relating such concepts to other important urban phenomena, such as Jacobs' (1961) ideas around street life.

2.1. What is a use?

Most often, discussion about mixing land uses revolves around residential, office and retail uses for their relative compatibility, especially the latter two. Likely for this reason, the importance of industrial or manufacturing uses is frequently overlooked (unless it involves converting them to lofts), as is the significance of parks and open space, although less systematically. Filion points out that the motivation for encouraging mixed-use in Toronto's suburban centres was to "attract [their] share of the [high order] office market" (2001, p145). Even transportation uses, such as roadways or parking, deserve consideration¹, which are sometimes indirectly included when permeability or connectivity is considered (for example, Hoppenbrouwer & Louw, 2005; Rowley, 1996).

Delineating distinct land uses is open to a wide range of interpretation. As a result, they are typically coarsely defined by zoning ordinances. Toronto's Official Plan, for example, broadly lists eight land use designations², which have yet to be clearly defined by the City's work-in-progress Zoning By-Law (City of Toronto, 2006). Particularly interesting is the City's 'Mixed Use Areas' land use designation, which incorporates a "broad range" of uses (City of Toronto, 2006, p. 4-10). As Lynch keenly observes, understanding what such a widely divergent range of uses might comprise requires understanding how differences between uses are perceived. This implies that defining uses is largely dependent on who is concerned with the land uses in the first place and why. If the concern is public health, then the classification of land uses would likely be based on long- and/or short-term health risks, such as noise, toxic emissions, etc. (for example,

¹ The urban land area in most developed countries devoted to roadways and parking hovers around 30%.

² Neighbourhoods, Apartment Neighbourhoods, Parks and Open Space Areas, Utility Corridors, Mixed Use Areas, Employment Areas, Regeneration Areas, and Institutional Areas.

Angotti & Hanhardt, 2001). If the concern is housing, then the scale of uses considered in an analysis of mixing might be limited to a residential unit types (for example, Skaburskis, 2006). As discerning land uses is based on function, it should not be limited to physical distinctions, but also include socioeconomic considerations, such as mixing affordable and market housing.

As is discussed in section 2.3, when considering which land uses can or should mix, it is important that the particular uses under consideration be precisely defined. The broad classifications typically used by planners “are no longer adequate and more specific designations need to be established” (Angotti & Hanhardt, 2001, p. 153). Key to any system of land use classification is scale (the relevant land uses) and understanding that the association of land and its use need not be one to one. Rather than identifying a site’s primary land use (implying land uses are mutually exclusive both spatially), one could identify a variety of land uses for a particular site.³ This allows considerably more precision in defining what mixes with what.

³ For example, land uses at theoretical site X could include more than one designation, such as ‘heavy vehicle shipping’, ‘toxic chemical storage’ and ‘office’.

2.2. What is mixing?

Once armed with a clear characterization of land uses, we can consider how they will mix. As Filion (2001) shows, even in suburban Toronto, centres labelled as mixed-use can assume a variety of urban forms (see Figure 1). What does it mean to be more or less mixed? The answer depends on the proportions of each use, how disparate these uses are, how they are distributed and the scale we are talking about.

Space

Spatial mixing is a commonly understood aspect of the mixed-use concept and potentially the easiest to analyze. Carefully defining a region of interest, which implicitly defines a scale of analysis, has significant implications on framing the characterization of mixing. As seen in Table 1, past studies have evaluated a wide variety of spatial scales, however, mixed-use is most often analyzed at some degree of neighbourhood scale. Calthorpe's (1993) Transit Oriented Development guidelines, for example, are built around a clearly defined spatial scale of mixing based on average walking distances.⁴ Rowley (1996) acknowledges the importance of scale in his theoretical analysis, but he limits his typology to only four scales (districts, streets, street-blocks, buildings). His 'street' and 'street-block' scales are essentially the same and he forgets about the city-wide or regional scales (Hoppenbrouwer & Louw, 2005), which, are still important when investigating how land uses mix as oppose to simply identifying mixed-use areas. Cervero's (1996) critical assessment of jobs-housing ratios as a policy mechanism to encourage a reduction in vehicle commuting is one such region-wide analysis.

The smallest spatial scale, mixing within buildings, has also recently received some attention from planners, although it tends to be more the domain of architecture. Hoppenbrouwer & Louw (2005) write of an interesting transition where mixed-use planning at Amsterdam's Eastern Docklands shifted from a district-level focus to mixing uses within premises. Hoppenbrouwer & Louw thus insist on distinguishing between the

⁴ TOD guidelines require that a wide variety of land uses locate within walking distance (usually considered 400m) of a major transit station (Calthorpe, 1993).

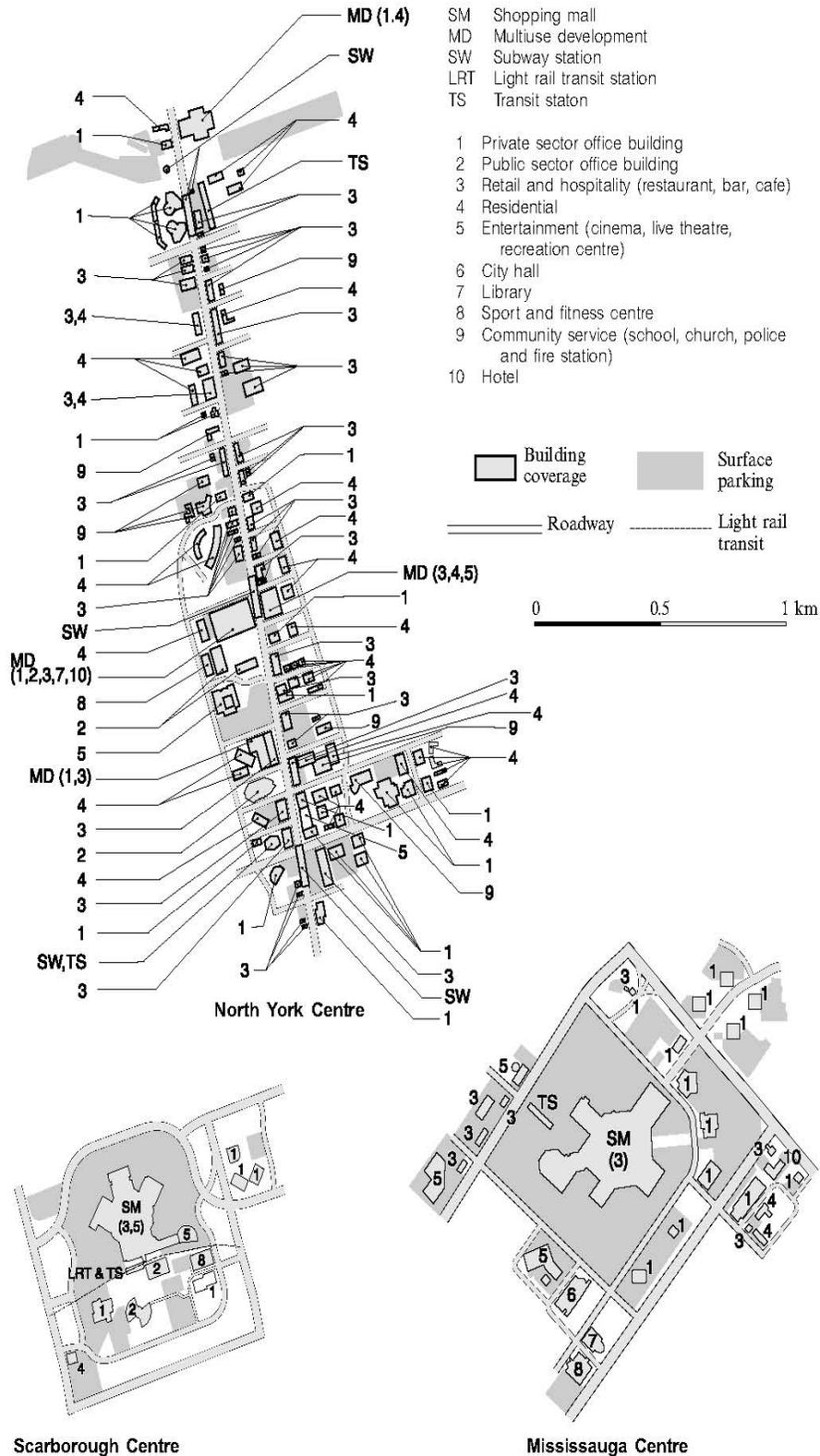


Figure 1

The three suburban “mixed-use centres” analyzed by Filion (2001).

horizontal, vertical, and shared premise dimensions of mixed-use. However, these are just an elaborate dissection of space at a particular scale which perhaps complicates more than it enlightens. Vertical mixed-use, as they call it, is nothing more than mixing within the same building. This may mean different uses above or below one another, such as apartments above retail or offices above a shopping centre. It may also mean shared uses within the same space. This layering of different functions over a particular area of land is also sometimes called *multiple land use* (Hoppenbrouwer & Louw, 2005). All of these are important considerations, but they do not necessarily represent new dimensions of mixed-use, just an understanding that space can be divided in many ways and uses do not necessarily occupy mutually exclusive areas of land. Of course, acknowledging the various scales of spatial mixing is of little consequence if available data is of an insufficient resolution, as was the case for Song and Knaap (2004), who's smallest unit of analysis was the lot. This, rather than theoretical short-sightedness, is likely the underlying reason behind most oversimplified interpretations of spatial mixing.

Time

Time is the third and potentially most enigmatic dimension of mixed-use. As such, it typically receives only cursory attention from academics and planners. Jacobs (1961) has always emphasized the importance of time since her initial writings on diverse street environments which include land uses that accommodate different schedules, sharing facilities, and mixed ages of buildings. She is, thus, alluding to two forms of land use change over time: short-term sharing of space and the process of long-term adaptation.

Rowley (1996) does recognize that buildings might be shared by a variety of users within the same day either regularly or occasionally. He also mentions the importance of considering the “life cycle” of property as space is adapted to support different uses over longer periods of time. He does not develop the concept any further than this, however. Hoppenbrouwer & Louw (2005) incorporate time into their typology, but without much explanation and this dimension remains ambiguous. It seems that they do not actually treat time as a dimension with possible scales of analysis, but rather, as something that is either considered or not. As with the spatial domain, scale is an

important consideration when thinking about evolving uses over time. One could discuss the uses throughout the day, such as a parking lot serving an office tower by day and a theatre by night, a public school used as a community centre in the evening, or a cinema used for conferences by day. This concept is usually wrapped up in the idea of synergy, which is discussed further in section 2.3. That is, when we speak of synergies between uses, we are often speaking of sharing space throughout the day.

As well, a mix of uses can evolve over a longer time frames. How can a neighbourhood or building support adapting to different uses over time? It is unlikely that developers of Toronto's King and Dufferin industrial area ever anticipated that it would take its present day form of supporting residential and office uses. Is it conceivable that today's

business parks could ever undergo the same transition? Why is it that some neighbourhoods seem more adept at supporting evolving to support a variety of uses compared to others? With increasing specialization of developments, adaptability becomes more difficult. Could a highway fast food strip, short of being demolished, someday support residential uses? How successfully could traditional suburban form, with its large setbacks and low densities, support retail? Scheer and Petkov argue that neither the Woodfield Center nor Irvine Spectrum (two sprawling ex-urban commercial centres in Schaumburg, IL



Figure 2 ▲

Toronto's Carpet Mfg. Company in Liberty Village which is now home to IT and new-media offices.

and Irvine, CA respectively) could ever “be more like traditional downtowns” (1998, p. 308).⁵ Even if they are right, this only considers what form would not support specific commercial uses. The broader question of what urban form is most adaptable to an unknown future remains unanswered. It is impossible to know how an area will evolve over time, but it certainly merits consideration.

Although Southworth is primarily concerned with walkability in New Urbanist developments, in his concluding reflections on the neotraditional paradigm he criticizes neotraditional models for being “sanitized versions of the small town” (1997, p. 43) due a lack of mixed-uses. He then suggests that, not only are New Urbanist developments in this sense “anti-urban”, but that their relatively homogeneous land uses are neither allowed nor encouraged to evolve over time, resulting in a lack of “identity reflecting the needs and tastes of individual inhabitants”. He is thus connecting ‘inauthentic’ reflections of community identity to neotraditional developments’ inability to adapt. Ellis also briefly speaks of the “alleged ‘inauthenticity’ of New Urbanist communities” (2002, p. 278), but he takes a more optimistic view on the potential for a New Urbanist development to evolve “in interesting ways” over time and address these accusations of ‘inauthenticity’ since they “mix uses and blend different housing types together” (2002, p. 278). This may well be true, but is this potential limited? In their typically suburban settings, perhaps they are authentic representations of local context, but how well might they support future contexts? How could this be evaluated? Ellis cites a faith in their mix of uses, but what mix of uses can New Urbanist developments realistically support? What might an adaptable urban form look like? These are all interesting questions which remain largely unexplored and depend somewhat on what we mean by mixed-use (see Table 1). It is interesting, assuming that such a capacity to evolve is important not only for reasons of place identity but also sustainability, how little this theme of long-term adaptability is mentioned by mixed-use advocates. Would the Congress for the New Urbanism even want to promote adaptability as it implies uncertainty in the future: the developer’s boogeyman.

⁵ Scheer and Petkov have two reasons for believing this. First, they feel the residential density would have to be six times what it is in order to support pedestrian friendly office and retail infill. Second, the street network is not sufficiently fine grained, streets are too wide and traffic is too fast.

It is important to consider not only the scale of time over which change happens, but the spatial scales that these changes occur in. Infill, lot subdivision and assembly, and building construction can happen incrementally over long periods of time or entire swaths of land can be “renewed” in a single phase of development, likely resulting in homogenous land uses. How and where change happens over time has a dramatic impact on a region’s mix of development periods, which, as Jacob’s (1961) argues, can have many implications on the region’s support for diverse activities.

Friedman (2002) talks about supporting changing uses at the building scale, specifically homes, and draws attention to some architectural details such as the significance of window placement and the kitchen as the space most often adapted to changing family needs. Although he gives a concise overview of the ways in which houses change, such as through the manipulation of volumes (urban configuration, ground relations, attachment to other homes) and growth and division, his focus is solely on homes and he offers scant evidence to support his claims. Furthermore, he does not consider which urban forms or buildings might more or less easily support other uses over time. After analyzing the changing block and parcel arrangements in North American and Australian cities, Siksna (1996) concludes that larger lots are more likely to change than smaller ones, which is not terribly insightful. He also casually mentions that “certain forms, sizes and arrangements of lots, blocks and streets have been more adaptable, and have performed better for both past and present development requirements.” (Siksna, 1996, p. 33), but he never explains exactly what these certain forms, lots, blocks and street topologies might be. Other typo-morphological studies have looked at the evolution of urban form over time in different contexts and often leap to general context-free assertions about how certain forms evolve. These studies relating form and adaptability through a historical analysis always struggle to untangle their findings from the local context of planning policy & regulation, property markets, building codes, and cultural ideas and values. Studying adaptability is challenging for exactly this reason.

Table 1 ▼

A summary of how many of the papers referenced in this study frame mixed-use based on the three dimensions outlined above.

Study	Uses	Time	Space	Impacts Analyzed (Indep. variables)	Location
Angotti & Hanhardt (2001)	<ul style="list-style-type: none"> Residential Industrial 	Present Day	Neighbourhood	Public Health	New York City
Cervero (1996)	<ul style="list-style-type: none"> Residential Employment 	Present Day	Regional	Commuting duration and vehicle miles travelled.	San Francisco Bay Area
Eid et al. (2006)	<ul style="list-style-type: none"> Residential Retail Churches 	Present Day	Neighbourhood (2 mile radius from each home)	Obesity (Body Mass Index)	U.S.
Filion et al. (2000)	<ul style="list-style-type: none"> Retail Office Residential 	Present Day	Suburban Centres (approximately 1km ² each)	Walking	Toronto GTA
Frank & Pivo (1991)	<ul style="list-style-type: none"> Single-family Multifamily Retail and services Office Entertainment Institutional Industrial 	Present Day	Census tracts	Transportation mode choice for work and shopping trips	Puget Sound, Washington
Friedman (2002)	<ul style="list-style-type: none"> Residential 	Long term	Home (lot)	Changes in home architecture	Dominantly North America
Minoura et al. (1997)	<ul style="list-style-type: none"> Residential (detached and apartments) Parks Industrial 	Present Day	Neighbourhood (approx. 6 hectares)	Accoustic disturbances	Sakai City, Japan
Skaburskis (2006)	Dwelling types: <ul style="list-style-type: none"> Single-family Detached Semiattached Town/row Apartment 	Present Day	Neighbourhood	Density	Markham (Cornell), Ontario
Song and Knaap (2004)	<ul style="list-style-type: none"> Detached Multifamily units Commercial Manufacturing Industrial Park Public institution 	Present Day	Centres	Housing prices	Portland Metropolitan Region

2.3. *Is the Mix Good or Bad?*

“Not all mixtures of uses make sense” (Agnotti & Hanhardt, 2001, p. 146).

Although enlightening, these three dimensions of mixed-use do not directly offer guidance in understanding whether a particular mix of uses is good or bad, that is, place mixed-use within a normative framework. To open this discussion, we need to contemplate the interactions between uses and how they are perceived.

Land Use Share and Variety

Arguably, the most intuitive method of measuring land use mix within a region is to compare the portions of land devoted to each use. This concept is often measured using statistical *entropy* (for example, Frank & Pivo, 1991; Song & Knaap, 2004), which is a normalized measure based on the number of land uses under consideration. This measurement, however, assumes that devoting equal portions of land to each use is ideal since that is the function's maximum value. Is 33% detached housing, 33% apartments and 33% office a good mix? It depends entirely on how land use categories are defined and what the goals of mixing uses might be. For example, considering the area devoted to building footprints, automobile uses, and parks and green space, North York has a more even split than downtown Toronto (Filion, 2001, p. 151). Expanding on this notion of entropy, one could also assess the *variety* in a particular land use mix by combining an analysis of land use *diversity* (that is, the number of distinct land uses considered in a mix) with a measure of the share of each.

Assuming we can define an appropriate variety or proportion of land designated to particular uses, this still is not sufficient to guarantee a successful mix. For example, the mixed-use objectives of the suburban centres analyzed by Filion (2001) only referred to the proportions of land uses (offices, shopping centres, entertainment, and residential), which were successfully achieved. The travel behaviour of those using the centres, however, was still largely automobile dependent (Filion, 2001). Evaluating whether a particular mix may work also requires careful consideration of the distribution of land uses and the synergies between them.

Distribution

There are countless ways to measure the distribution of certain uses within a certain space and time. Land use mixing can take on markedly different configurations as seen in the three suburban mixed-use analyzed by Filion (2001 - see Figure 1). The retail in the North York centre is street-level, whereas the retail in the Scarborough and Mississauga centres is concentrated in shopping malls. Furthermore, in the North York centre, Filion notes that retail tended to reproduce the same configurations.⁶ The uses are not very dispersed and, although densities are high, large tracts of the land between these uses is devoted to parking. Thus, analyzing spatial dispersion, sometimes referred to as interweaving, is also critical to understanding mixed-use (see Figure 3).

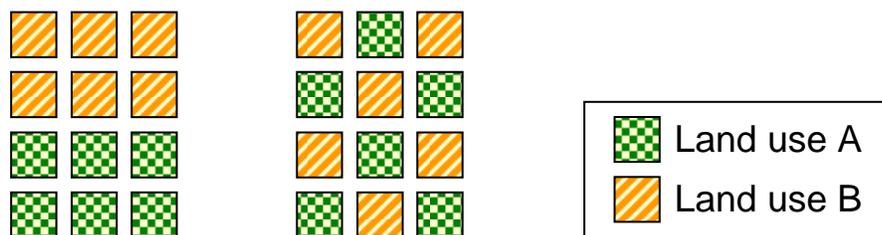


Figure 3 ▲

On the right, a much more dispersed pattern of land use mixing despite identical shares and variety of land uses.

Transportation uses deserve special consideration. *Connectivity* or *permeability* is often mentioned in mixed-use literature, although it is unclear whether this notion should be an integral part of defining mixed-use, as is promoted by Hoppenbrouwer (2005) and Rowley (1996). Connectivity is, in a sense, a measure of the distribution of public space. On the one hand, the public space network is only one land use of many, and its layout should be inconsequential to evaluating mixing. On the other hand, it does act as the connective tissue between all other land uses and, thus, plays a role in defining how uses spatially mix. All things equal, can one area have poorer connectivity yet more mixing than another or vice versa? I tend to believe connectivity is a distinct concept and does not necessarily have much influence over the mixed character of an area, but the jury is still out (see Figure 4 for an illustration).

⁶ I understand this to mean both similar spatial distributions and a limited variety in the retailers themselves.

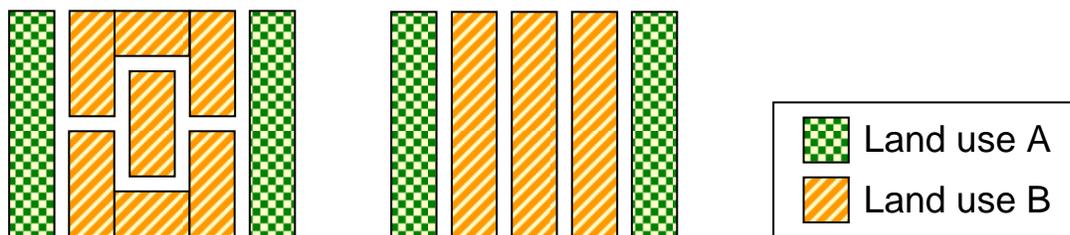


Figure 4 ▲

Two different street patterns different levels of connectivity yet both have approximately the same area designated for each land use (including transportation). Do these represent different land use mixes?

Another important concept related to spatial and temporal distributions of uses is *transition*. Transition from one cluster of uses to an adjacent cluster can be sharp or gradual (sometimes referred to as blurred). This concept is often also referred to as *granularity* (Filion, 2001; Grant, 2002; Hoppenbrouwer & Louw, 2005; Rowley 1996), which comes from the notion of coarse or fine grain urban form (see Figure 5). Measuring it, as with any measure of land use distributions⁷, is hugely dependent on scale, the resolution of available data, and what are perceived as different uses and the disparity between them.

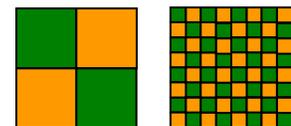


Figure 5 ▲

Coarse vs. fine grain.

Interconnection

There are two important aspects to considering the interaction between land uses. The first is *compatibility*. That is, interference between land uses. Certain activities demand separation from other uses. The presence of compatible uses only implies that conflict is avoided and not that there is any synergy between the land uses (Grant, 2002). When mixing with residential uses, issues of compatibility are particularly acute. Song & Knaap (2004) explore the impact of surrounding land uses on housing prices and find that compatibility with single-family residences is key. Agnotti & Hanhardt (2001) remind us that some industrial uses pose serious health hazards and Minoura et al. (1997) point to the importance of acoustics. Industrial health or quality of life risks may come

⁷ Aside from entropy, I have not seen many statistical indicators, even as simple as central tendencies, applied to land use distributions across time and space to characterize land use mixing.

from truck traffic, dump sites, toxic materials, fumes, vibrations, etc. (Agnotti & Hanhardt (2001). Bakeries and restaurants can produce odours that, over time, are nauseating and noise from restaurants and nightclubs can cause stress and sleep deprivation. Even air-conditioning units can seriously affect nearby air quality and generate intolerable noise. “Although most of these uses are clearly appropriate in mixed-use communities, it is imperative that the potential health and quality-of-life problems be addressed” (Agnotti & Hanhardt, 2001, p. 148).

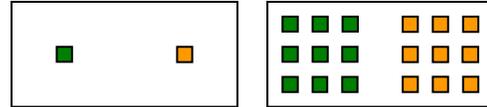


Figure 6 ▲

Two areas with identical land use mixing, but very different densities.

Grant (2002) and Agnotti & Hanhardt (2001) are confident that some industrial uses are compatible with residential uses (even after they list a plethora of problems with this mixture) but Agnotti & Hanhardt (2001) point out problems with existing statutes in the U.S. They control the emission of specific substances designated as either hazardous or extremely hazardous, however, this form of regulation is not able to control the cumulative effects or interactions between these emissions. For example, they do not address concentrations in high-density areas. Similarly, impact assessments generally only consider facilities in isolation, and do not incorporate the cumulative effects of other developments within the same area. Municipalities are increasingly interested in performance based zoning, which allows any use to locate next to another provided that it meets predetermined performance standards related to noise, hours of operation, views, etc. (Alexander & Tomalty, 2002). Despite this legislative attention, Grant (2002) makes the point that compatibility can be very subjective and a community’s willingness to accept supposedly compatible uses often depends more on non-technical factors, which are beyond the scope of this paper.

The second aspect to interaction between land uses is the concept of integration, sometimes referred to as *synergy*, “*interfunctional integration*” (Filion, 2001), or, in the realm of economics, *agglomeration economies* (Coffey & Shearmur, 2002; Filion, 2001; Hoppenbrouwer & Louw, 2005). The idea is that two or more uses mutually benefit from

their spatial and/or temporal proximity. For example, a public school which supports community activities in the evening, professional services locating in Toronto's PATH network beneath office towers, or a late-night restaurant sharing parking space with an adjacent law firm. Naturally, greater intensities or density of land uses help to reinforce this integration (Gehl, 1987; Jacobs, 1961), but density is considered separate from the concept of mixed-use (see Figure 6), contrary to interpretations by Grant (2002) and Hoppenbrouwer & Louw (2005). Again, this integration of uses is not guaranteed by compatibility alone. For example, Hoppenbrouwer & Louw (2005) point out that most employment mixing in Amsterdam's Eastern Docklands were commercial services; a sector that does not attract much street activity. This leads Hoppenbrouwer & Louw to question "whether the benefits of mixed-use, such as promoting vitality, are really achieved within development of the Eastern Docklands" (2005, p. 981). Therefore, we cannot naively assume mixed-use will bring productive interaction between mixed land uses and it is important to carefully consider what the interactions between particular land use mixes may or may not involve.

Impacts

The list of potential benefits to well integrated land use mixes is long, but these supposed independent variables are not well understood in this context and some are very difficult to analyze empirically, such as urban vitality. Hoppenbrouwer & Louw (2005) point out that mixed land uses carry implications beyond simply the physical realm (indeed, these "implications" are the reasons behind advocating for mixing uses in the first place). They list "the urban experience, the nature of uses, definitions of public and private, conflict and security" and I would add travel behaviour, street activity, and land value. They write these off as "marginal notes", but these are important considerations when thinking about mixed-use and each involve slightly different interpretations of exactly what mixed-use environments we are talking about. The interaction between these effects and particular mixes of uses is only weakly understood and considerable research remains to be done.

3. Conclusion

Unfortunately, it seems mixed-use development is not the planning cure-all. The concept offers potential, but also demands careful consideration of the complexities involved in mixing uses. Planners must move beyond simply labelling a development as “mixed-use” if the term is to hold any meaning and contribute valuable insights to Smart Growth, Compact City, Sustainability, or New Urbanist inspired policies.

This literature review shows that the concept of mixed-use can be reduced to three dimensions: functional, spatial, and temporal, each with their own complexities. Along all three dimensions, scale is not always implicitly acknowledged and is usually only thought of in spatial terms, but scale is equally relevant when thinking about time and land use categories. This dissection of land use mixing helps to simultaneously clarify and broaden the definitions of some often ambiguous concepts commonly used in the mixed-use discourse, such as variety, diversity, dispersion, intensity, connectivity, and granularity. This theoretical framework also helps to frame past research and identify weaker realms of understanding. Considerable mixed-use research is needed, especially around long-term adaptability, to better define effective land use mixes for achieving our sustainable city goals.

With so much interest coalescing around the idea of mixing land uses, why is its implementation proving to be such a challenge? Rowley (1996) asserts that it is likely easier to simply conserve existing mixed-use neighbourhoods than it is to develop new ones. Attempts to enhance land use mixing over the past two decades have met significant resistance and timid market interest. Obstacles are found both in new developments based on mixed-use principles and urban infill and redevelopment projects. Perhaps some of these impediments are exaggerated by the ambiguity around mixed-use terminology? Not only do we need to better understand which uses mix well, but also how such mixes can be effectively implemented. The theoretical framework outlined in the paper will help to frame this essential next step, as planners continue to try and swim upriver, against the dominant cultural, political and socioeconomic forces pushing to segregate land uses even further.

4. References

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