PLANNING MALAYSIA:
Journal of the Malaysian Institute of Planners
VOLUME 15 VOLUME 1 (2017), 305 - 318

BIBLIOMETRIC ANALYSIS ON QUANTIFYING URBAN SPRAWL IN ASSESSING A COMPREHENSIVE MEANING OF SPRAWL: A REVIEW

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Abstract
After more than half century has passed, urban sprawl remains as one of the most important and unresolved matters in the urban development process. This paper adopts "Bibliometrics Analysis" technique, which is a statistical analysis of scientific publications to review the studies on urban sprawl from the year 1996 till 2015 in order to identify the fundamental issues and problem of urban sprawl. This method allows the researcher to review the literature of topic of interest critically, not only based on national and international networks but includes the multi-disciplinary fields of science and technology relating to urban planning. The publications on urban sprawl were retrieved from the two largest scientific databases namely Scopus and ScienceDirect. The sampling of publications was based on the "Most Cited Articles" indicator. The findings on urban sprawl issues and problems are presented in four categories, which are the lack of consensus in defining urban sprawl, unavailability of method to quantify urban sprawl, access to data and tools, and varying urban sprawl patterns based on area. The findings of this study provide the gap for future research on urban sprawl.

Keyword: Urban sprawl, sprawl issues and problem, urban sprawl planning, bibliometric analysis.

Date Received: 30th April 2016
Date of Acceptance: 30th October 2016

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INTRODUCTION

The paper uses "Bibliometrics Analysis" technique to analyse research publications on urban sprawl topic ranging from 1996 till 2015 in order to extract the relevant issues and problems of urban sprawl. Since the term became apparent in the 1950s, "Urban Sprawl" has been globally studied by researchers from various backgrounds and interests. Unfortunately, even after a few decades have passed, the definitive way to define urban sprawl is still absent. Urban sprawl is a fundamental issue in modern urban development since its rapid, but uncontrolled expansion is alarming for many professionals in the built environment (Altieri et al., 2014; Arribas-Bel, Nijkamp & Scholten, 2011). Some researchers agree that urban sprawl is something undesirable and have more negative impact rather than positive consequences (Ewing, 2008; Ewing et al., 2016; Ewing, Pendall & Chen, 2002; Knaap et al., 2005). Urban sprawl is a broad term involving different characteristics and types, and caused by various factors, thus different approaches are needed to address them (Majid & Yahya, 2010, 2011). Advocating for certain development concept or planning policies may not necessarily be successful without initially knowing the key issues and problem of sprawl faced by a city (Chorianopoulos et al., 2010; Habibi & Asadi, 2011).

THEORETICAL REVIEW ON URBAN SPRAWL

According to Wu (2006), a city is a highly complex socio-economic and spatial entities with a distinct hierarchical order. It is a hub of almost all human activities (Rajeshwari, 2006). Apart from physical forms, cities are shaped by various development forces such as economic, political, cultural and social, which later imposing themselves in physical forms and closely relate to urban sprawl (Apostolos, 2007; Ardeshiri & Ardeshiri, 2011).

In Western countries, urban development is characterized by two important processes which are the inner-city decline and urban sprawl. These two processes are in fact interrelated as urban sprawl accelerates the inner-city decline. Bhatta, Saraswati and Bandyopadhyay (2010b) consider "Urban Growth" and "Urbanisation" are both the processes of "Urban Development." Meanwhile, urban growth and urbanisation as defined by EEA (2006) are "the increase in the number of people living in towns and cities" and "the proportion of a country that is urban". The process has a high impact on the environment such as depletion of natural resources, landscape deterioration, pollution and climate changes (Olujimi, 2009; Ramachandra, Bharath & Sowmyashree, 2014; Weng, 2001).

Based on the growing awareness of the public on the uncontrolled urban development issues, it is vital to improve understanding of this phenomena and their underlying causes (Rajeshwari, 2006; Verbeek, Boussauw & Pisman, 2014). However, some scholars also argue that urban sprawl is inherent to city growth and that it will always continue to be a side effect of urban development process

(Steil, Salingaros & Mehaffy, 2007; Almeida, 2005; Bhatta, Saraswati & Bandyopadhyay, 2010b; Altieri et al., 2014). Thus, what is required is not halting urban sprawl but to lessen its negative impacts in order to promote sustainable development (Steil, Salingros & Mehaffy, 2001).

Sprawl has become a characteristic of urban development worldwide. Urban sprawl has became one of the most important issues in the urban area around the world since the twenty-first century whose importance is still growing today (Altieri et al., 2014; Arribas-Bel, Nijkamp & Scholten, 2011). Its rapid and uncontrolled expansion are alarming for many professionals including planners, urban specialists, statisticians, engineers and decision makers Arribas-Bel, Nijkamp & Scholten, 2011; Bruegmann, 2015; Ewing, Pendall & Chen, 2002). On the contrary, sustainable development concept espouses development that meets the requirements of the present without conceding the capability of upcoming generations to meet theirs. (Ardeshiri & Ardeshiri, 2011; Tanguay et al., 2010). The sustainable development concept has become increasingly significant for creating a better future for the world, economically, socially and environmentally (Arbury, 2005). As a result, this concept depends on the future role of urban planning in handling urban sprawl issues (Catalán, Saurí & Serra, 2008; Yeh, 2000).

METHODOLOGY

Bibliometric analysis was used to obtain reliable information on urban sprawl issues and problems. Bibliometric analysis offers a powerful set of methods and measures for studying the structure and process of scholarly communication. Besides, this method is expected to play an increasingly important role in research assessment and management (Campbell et al., 2010; Bellis, 2009; Borgman & Furner, 2002). Also, bibliometric indicators which quantify the production and use of bibliographic material, have been used extensively in the assessment of research performance (Russell & Rousseau, 2010; Campbell et al., 2010; Bellis, 2009; Reuters, 2008). The scientific databases used to collect journals and articles include Scopus, ScienceDirect, and Web of Science ranging from the year 1996 to 2015 (20 years) as the principle search parameter. Specific keywords were retrieved from the title and abstract of each journal and article using Boolean Searching technique for urban sprawl publications of different subject areas. The enormous numbers of publications for this topic were then limited by "Most Cited Paper" for each year making the final document analysed pertinent to the interest of this paper only 100 records from all databases. Based on the selected publications, a detail and comprehensive analysis on the content of the literature review was conducted using content analysis technique to extract the issues and problems of sprawl.

The results from Bibliometric analysis not only provides valuable information on the scientific trend and pattern of urban sprawl studies but assist

the researcher in indicating the most important and relevant issues and problems associated with urban sprawl for the last 20 years. The findings were discussed into four categories of challenges namely (i) urban sprawl, (ii) geospatial indices, (iii) GIS and remote sensing, lastly on (iv) the different urban context. The identified issues and problems stand as the gap in determining urban land use sprawl through geospatial indices measurement method using GIS and remote sensing.

ANALYSIS AND FINDINGS

The term "Urban Sprawl" is a concept that is vague in its definition. Despite being vigorously researched into, urban sprawl remains to be without a universally accepted and well-established definition (Altieri et al., 2014; Arribas-Bel, Nijkamp & Sholten, 2011; Barnes et al., 2001; Bhatta, 2010; Bhatta, Saraswati & Bandyopadhyay, 2010a, 2010b; Bruegmann, 2015). Bibliometric analysis on urban sprawl publications (Table 1) shows that publications on urban sprawl topic have been increasing since 1996. This indicates a growing awareness among academicians and professionals on urban sprawl. However, publications that emphasise on defining urban sprawl are still lacking. For over 20 years, only 20% of the publications focus on defining urban sprawl. The lowest publication on urban sprawl studies is from medicine subject area (4.1%), business, management and acccounting (4.8%), and economics, econometrics and finance (5.6%), proving that there is some form of disregard of urban sprawl importance in some subject areas.

Lack of awareness on sprawl issues from some areas cause the efforts to contain sprawl sometimes resulted in increasing another (Coisnon, Oueslati & Salani, 2014, 2012; Galster et al., 2001; Gottlieb, 1999; Ngoran & Xue, 2015; Wu et al., 2006). Besides, the analysis of the pattern of urban sprawl publications also indirectly explain why there are so many unintegrated methods and tools to measure sprawl. In terms of the urban context, the United States is the leading country in the urban sprawl research with 1,127 documents published in 20 years period. The publication gap between the Unites States and China (391) is 736 publications. The huge difference proves that urban sprawl issues first acknowledged and conducted in the United States. Most of literature and debates on urban sprawl also have been based on the US experience (Chorianopoulos et al., 2010; Habibi & Asadi, 2011; Nechyba & Walsh, 2004; Travisi, Camagni, & Nijkamp, 2009). China is taking the lead in the context of Asian Countries, followed by India (91 publications) and Japan (49 publications). Countries with a low number of research publications are either developing or third world countries that faced problem such as over-populated, slum area, congestion and apparently sprawling.

Table 1 Publications on Urban Sprawl

		Urban Sprawl			Urban Sprawl Definition		
	Year	**Scopus**	**Science Direct**	**Web of Science**	**Scopus**	**Science Direct**	**Web of Science**
1.	**2015**	314	821	132	8	379	9
2.	**2014**	331	663	136	8	278	7
3.	**2013**	310	661	111	8	290	8
4.	**2012**	296	562	98	9	250	1
5.	**2011**	265	404	90	5	160	6
6.	**2010**	238	316	87	3	151	2
7.	**2009**	202	373	90	4	148	2
8.	**2008**	217	339	63	5	150	1
9.	**2007**	170	261	55	4	105	1
10.	**2006**	143	259	41	4	110	1
11.	**2005**	147	186	36	12	76	3
12.	**2004**	118	212	35	4	77	2
13.	**2003**	108	158	17	7	68	5
14.	**2002**	81	135	17	3	56	1
15.	**2001**	86	173	26	3	64	3
16.	**2000**	57	107	12	1	37	1
17.	**1999**	37	63	7	0	24	0
18.	**1998**	37	72	7	1	27	1
19.	**1997**	25	106	4	0	47	0
20.	**1996**	25	92	5	0	39	0
TOTAL		**3,207**	**5,963**	**1,069**	**89**	**2,536**	**56**
			10,239			**2,679**	

Sources: Scopus, ScienceDirect, WoS

DISCUSSION OF ISSUES AND PROBLEMS

Urban Sprawl

Unavailability of agreeable definition for the term

Urban sprawl is a term that has a long history in the academic and development practice. Nonetheless, it is still widely discussed as a major problem today (Coisnon, Oueslati & Salani 2014). Surprisingly, a standard and precise definition of urban sprawl is still not existed (Altieri et al., 2014; Bruegmann, 2015; Terzi & Kaya, 2008; Theobald, 2003; Wilson et al., 2003). Bhatta, Saraswati and Bandyopadhyay (2010a) claim urban sprawl as a concept suffers from difficulties in the definition. Hammer and Witten (2011) question if there is a single widely accepted definition of sprawl on which the majority of stakeholders can agree. Hasse and Kornbluh (2004) add that there is a need to better define the term to focus specifically on the undesirable and problematic development that many stakeholders are arguing.

According to Ewing (2008), Ewing, Pendall and Chen (2002, and Galster et al. (2001), most people especially professionals may recognise sprawl when they see it, but this may not be helpful in practice especially in the rule or decision making. Currently, sprawl has been loosely defined as dispersed and inefficient urban growth that is always associated with characteristic such as low-density, decentralization and fragmentation (Farber & Li, 2013; Hasse & Lathrop, 2003). Without a universal definition, quantification and modelling of urban sprawl are difficult (Bhatta, Saraswati & Bandyopadhyay, 2010b; Wilson et al., 2003). Moreover, Bruegmann (2015) also states that there has been a significant debate in academia on how to measure sprawl and to understand its dynamics, thus a universal definition of urban sprawl is required.

Ambiguous ways in determining the urban sprawl concept

Urban sprawl is a critical issue in today's world. While being a manifestation of development, it is known for its negative environmental and social impacts (Crawford, 2007; Feng et al., 2015). Over the years, urban sprawl concept has been defined in many ways by many different groups with each definition seemingly only serving each particular group's interest (Haase & Nuissl, 2007; Hammer & Witten, 2011; Ngoran & Xue, 2015). As a matter of fact, not all urban growth is considered as sprawl and one person's sprawl can be another person's solution to sprawl (Almeida, 2005; Gottlieb, 1999). Numerous studies have revealed the nature of urban sprawl and the reasons for its occurrence in different contexts (Coisnon, Oueslati & Salani, 2014). Much of the confusion about sprawl, especially on causes, consequences and conditions, stems from the conflation of ideology, experience, and effects (Galster et al., 2001).

Universality: Sprawl from a broader context

As pointed out earlier, the term ''urban sprawl'' is loose and ambiguous. It can be seen that urban sprawl is not only important issue for urban specialists, planners, and statisticians, but this issue expanded to the mainstream. The rapid and uncontrolled urban expansion in the world is alarming, both in developed and developing countries (Altieri et al., 2014; Banzhaf & Lavery, 2010; Bruegmann, 2015; Wassmer, 2007). However, this variety of views and understandings on the matter may also enrich the analysis if performed universally (Arribas-Bel, Nijkmap & Scholten, 2011; Barnes et al., 2001). Urban development process without sufficient understanding of its wider context leads to inadequate interpretations of sprawl and its impact (Altieri et al., 2014; Bhatta, Saraswati & Bandyopadhyay, 2010b; Chorianopoulos et al., 2010). Ewing (1997) prove that there are different standpoint of viewing and defining urban sprawl from town planners and economists perspectives. Anas and Pines (2008) and Vyn, (2012) explore the idea of studying the relationship between different aspect of sprawls

that proved unintegrated development policies might reduce sprawl in one aspect but increase in another.

Other issues and problem associated with urban sprawl

Urban sprawl is a serious challenge for urban management and planning in many countries (Gennaio, Hersperger & Burgi, 2009). Assessment of the environmental and socio-economic impact of sprawl fails to find the solution and is still a subject of debate (Haase & Nuissl, 2007). Furthermore, many urban management strategies for sustainable development such as compact city, smart growth and green city concept contradict one another and failed to curb sprawl comprehensively (Arbury, 2005; Ardeshiri & Ardeshiri, 2011). Besides, urban sprawl has contributed to the deterioration of the quality of life. A study by Ewing et al. (2014) shows that adults living in sprawling counties have a higher body mass index (BMI) and are more likely to be obese than are their counterparts living in compact cities.

Sprawl is widely discussed but poorly understood. It may mean different things to different people. However, most observers seem to agree that sprawl can be characterized by a fragmented pattern of land development (Wu, 2006). However, Gottlieb (1999) claims that many economists do not see sprawl as a problem nor acknowledge its existence because the fragmented pattern of city growth is a result of fair-market being in operation. Many economists also argue that sprawl occurs due to market failures and lack of useful integrated economic model (Anas & Rhee, 2006; Brueckner & Helsley, 2011; Nechyba & Walsh, 2004). In contrast, urban planners and policy makers favour land use controls that directly limit the expansion of cities and encourage high-density development in central cities, which are widely presumed to reduce sprawl (Ewing, 1997).

Geospatial Indices

Distinguishing urban development from urban sprawl

As urban development occurs, its growth is often confused with urban sprawl. Ewing (2008) suggests that there are three dimensions associated with urban development namely land use, density and time. The same dimensions also apply to sprawl. However, to what extend the growth is dispersed or compact remain as a problem (Almeida, 2005; Burchfield et al., 2006; Tsai, 2005). Additionally, understanding on urban sprawl, especially in Asian countries, still heavily relies on qualitative discussion instead of quantitative analysis (Feng, 2008). Some scholars propose that urban sprawl needs to be quantitatively measured in order to determine whether it is on the rise or decline, and whether it is a recent occurrence or has been evident for a long time (Gerundo & Grimaldi, 2011; Bruegmann, 2015).

Limitation in capturing the characteristics of urban sprawl in measurement

As mentioned earlier, many definitions use characteristics such as low density or dispersed development to identify urban sprawl. However, these features are not adequately defined or explained, nor these can comprehensively determine urban sprawl (Ardeshiri & Ardeshiri, 2011; Couch & Karecha, 2006). As different factors caused various types of sprawl, different approaches are required to address them. Any measures taken without first knowing what kinds of sprawl the city is facing may not necessarily work (Majid & Yahya, 2010; Verbeek et al., 2014). Numerous researches were dedicated to the measurement or urban form, but they have limitations in capturing the overall characteristics of urban sprawl. (Almeida, 2005; Jaeger, Bertiller, Schwick, Cavens & Kienast, 2010; Jaeger, Bertiller, Schwick & Kienast, 2010; Li & Yeh, 2004; Steil, Salingaros & Mehaffy, 2007; Yeh & Li, 1999a, 1999b). Bhatta, Saraswati and Bandyopadhyay (2010a) assert that effective way to identify sprawl can never be achieved without first defining its solid characterisations. However, this is not an easy task since previous researches on characterising sprawl have either failed to draw a conclusion or cannot be universally implemented.

Managing urban sprawl from different geographical background

According to Ewing et al. (2016), there is rather limited researches that explore the global characteristics of urban development and urban sprawl as well as their implications for equity and sustainable development. Gennaio, Herperger and Burgi (2009) relate this problem to the difficulties in comparing the international urban development due to diverse databases. They found that different countries have different databases and in many cases, the data is different between cities, counties and states of the same country.

GIS and Remote Sensing Application

Availability of routinely update database

Frequent monitoring of urban sprawl is needed to limit the impact of this phenomenon towards the environment. Thus regularly updated data is required for that purpose Altieri et al., 2014; Durieux, Lagabrielle & Nelson, 2008). As highlighted beforehand, there are not many quantitative contributions in urban sprawl research as compared to the qualitative discussion. One probable reason for this scenario is the limited availability of good and reliable data (Arribas-Bel, Nijkamp & Scholten, 2011). Information on urban development especially in developing cities is often unavailable, due to their rapid development and capacity constraints of planning authorities to keep track. The ability to assess, measure and monitor sprawl depend on the availability of relevant, accurate and reliable data (Altieri et al., 2014; Belal & Moghanm, 2011; Bhatta, Saraswati & Bandyopadhyay, 2010b; Feng, 2008; Herold, Couclelis & Clarke, 2005; Osman, Nawawi & Abdullah, 2008).

Lack of synchronizing tools/methods to control urban sprawl

Allen and Lu (2003) state that modelling and predicting urban growth has begun in the 1950s, but slowed down during 1970s to 1980s. Recent availability and improvement of spatial data combined with the advancement of geographic information system and computer technologies, the activities have again increased since the 1990s till now. However, there are still very few methods used to assist in the identification and monitoring of urban sprawl in development areas. Therefore, there is a clear need for such method to be used with geospatial databases from GIS and remote sensing data (Altieri et al., 2014). Anas and Pines (2008) argue that if local urban planners and decision makers were to use uncoordinated land use policies that are generated based on less accurate data and inadequate evaluation methods, the overall urban sprawl rate may increase and cause shuffling of population among neighbouring cities. Last but not least, the recent demand for the data with high resolution and accuracy as well as the latest technology of geospatial tools. The high cost of data acquisition and tools used to process the data has affected the stages in conducting research and the quality of outcomes (Gamba, 2009).

Urban Context

Excessive concentration on urban sprawl experience from specific urban context

Many researchers have come to conclude that modern debates on the urban form and urban sprawl have become influenced strongly by the result of an excessive concentration on American experiences, hence, leading to neglecting of experience from urban context of other countries. Urban sprawl occurrence varies in different context due to various economic, geographic, environmental, social and political situations (EEA, 2006; Castracane et al., 2003; Catalán, Sauri & Serra, 2008; Chorianopoulos et al., 2010; Couch & Karecha, 2006; Habibi & Asadi, 2011; Nechyba & Walsh, 2004). Most of the developing countries particularly in Asia suffer the absent of clear quantitive approaches to indicate sprawl and way to evaluate the extent of its growth (Feng, 2008). Moreover, there is a growing awareness from researchers in Europe, Asia and Africa on the issue where majority of the literature on sprawl focuses on American urban areas (Travisi, Camagni & Nijkamp, 2009). Based on the bibliometric analysis conducted for this research, it can be seen that as of 2015, the United States of America has the highest number of published literature on sprawl. For Asian countries, China and India are taking the leads while Malaysia is still in infancy stage. Osman, Nawawi and Abdullah (2008) proclaim that in Malaysia, there is relatively low visibility of urban issues and there seemed to be many lingering problems which were the outcome of the urban development process for the past thirty years. The development process influenced by globalisation and economic

competitiveness factors that seen many main cities as economic growth engines, so the control of its previous expansion almost not exists. The intensification of urban sprawl within the three top Malaysia's metropolitan areas has led to greater growth in urban areas outside the city centre boundaries (Abdullah, 2012).

CONCLUSIONS

The paper provides an insight of the current trend and status of urban sprawl studies based on published literature through most used scientific databases. By doing so, the researcher was able to find most relevant and reliable sources of research information on urban sprawl to extract the issues and problem. Examining the issues and problems of this topic helps the researcher to find the most significant research gap, and the best solution can be explored. The author explores the Bibliometric analysis technique, which is the best known of sophisticated approaches, in evaluating the qualitative literature into quantitative assessment (Borgman & Furner, 2002). This paper contributes to determining the research gaps for author's research on 'Developing Land Use Geospatial Indices (LUGI) in Measuring Urban Sprawl using GIS and Remote Sensing Techniques: Case Study of Kuala Lumpur."

ACKNOWLEDGMENT

The authors greatly acknowledge the support from IIUM. The authors also thank all the reviewers for their comments and suggestion for the improvement of this paper.

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