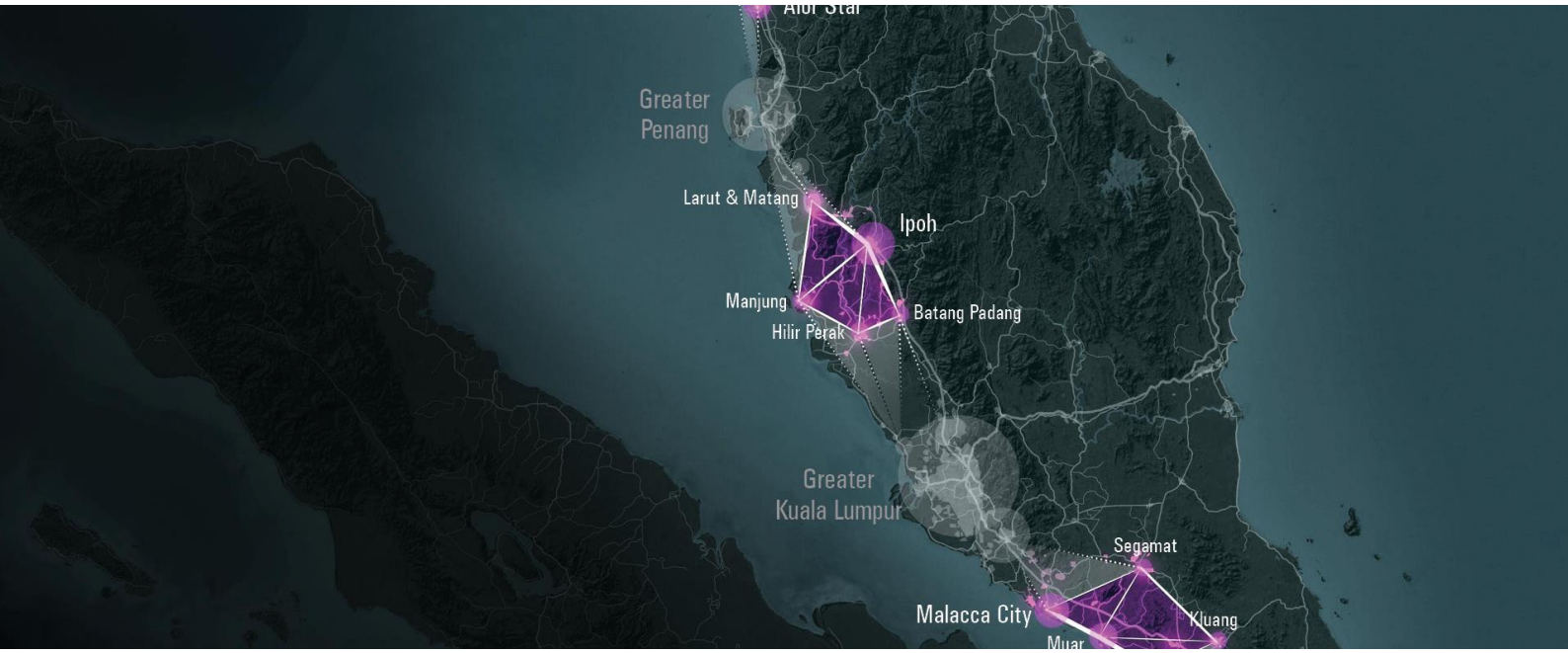
URBAN FUNCTIONS IN THE PERAK DIAMOND

A consideration of functional polycentricity



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1. INTRODUCTION

1.1. BACKGROUND

Mass of people can create agglomeration economies, wheter this is based on specialisation, diversity or competition (De Groot et al., 2007), it can be said that regions that host more people and functions accumulate even more people and thus the larger the conurbation, the larger it tends to grow (Martin & Ottaviano, 1995). This fear is also recognized by Malaysian policymakers and one of the pillars is to stimulate actions that will prevent Kuala Lumpur from growing into a *'a single overwelming primate city' (*NPP-3, 2016). In the search for an entity that has the ability to compete Fundación Metropoli & Thinkcity (2018) suggested the "Perak Diamond": a polycentric region of interconnected urban centres located in the west of the state Perak inbetween Penang and Kuala Lumpur (figure 1). Altough the Perak Diamond looks good on paper there is lack of data to prove wheter this diamond actually exists. This research will gather data, specifically on urban functions to get a better understanding of the regions interconnectedness and the existence of this so-called "Perak Diamond".

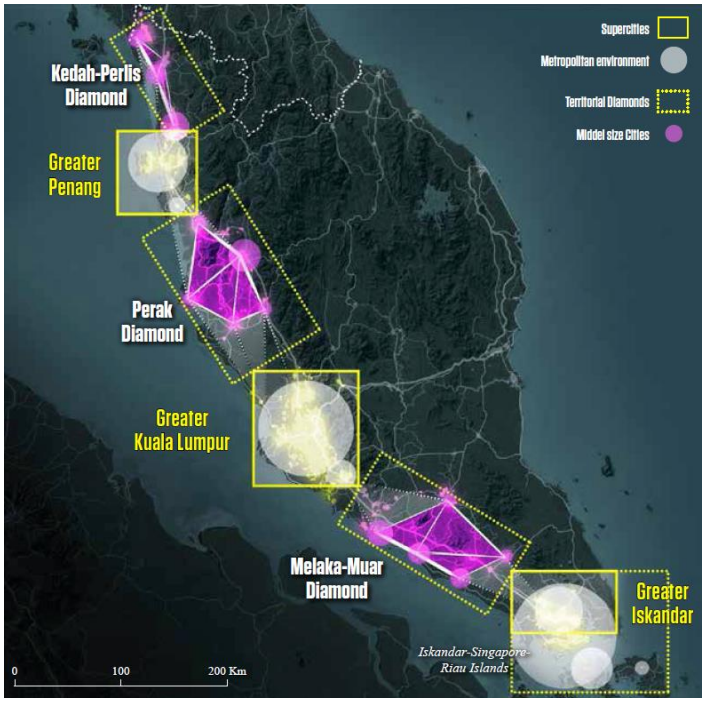

FIGURE 1 - LOCATION OF THE PERAK DIAMOND IN PENINSULAR MALAYSIA (FUNDACIÓN METROPOLI & THINKCITY, 2018)

1.2. URBAN FUNCTIONS

The goal of Malaysian policy is to "make the country an attractive place to live, work, play, invest, do business, and visit" (NPP3, 2018). *"It is held though that wide distribution of urban development resources and isolated development of regional and smaller urban centres – being equally real in Peninsular Malaysian urban development – results in productivity ineffectiveness" - (*Fundación Metropoli / ThinkCity, 2018). To achieve these goals the Malaysian government divided all urban conurbation into different hierarchies. This hierarchical approach does not necessarily contribute to achieve this goal and therefore a more defragmented and polycentric approach has to be considered to benefit from connections and interactions and allowing the urban settlements to profit from positive agglomeration externalities (e.g. Porter, 1996) and 'borrowed size' (Burger Meijers, Hoogerbrugge & Tresserra, 2015). This research will use the concept of borrowed size to assess the grade of polycentrism in the Perak region by investigating the distribution of metropolitan urban functions and the flow of people who use these urban functions. The central place theory stated that there is a connection between the size and hierarchy of urban centres and the hierarchy functions.

In a fully interconnected urban region there should be urban functions that are characteristic for the combined mass of all urban centres in this region and those urban functions can in theory be in any of the interconnected urban centres. This means that in an interconnected region there are cities that host functions that are in

hierarchy too high for the size of the urban centre; the urban centre itself does not have enough mass to host the function, but *borrows size* in the form of people from other urban centres it is interconnected with. At the same time there are urban centres lacking functions, because they are hosted by other interconnected urban centres and competition leads to the emergence of *agglomeration shadows.* (Burger et al., 2015). This research will therefore use the presence of urban functions and the concepts of borrowed size and agglomeration to assess the interconnectedness of urban centres in the Perak Diamond.

1.4. RESEARCH GOAL

The aim of this research is to add to the lack of data there is in Malaysia and especially within the Perak Diamond to get a better understanding of the urban system of this region. The report written by Fundación Metropoli and ThinkCity has led to the question whether one can speak of a polycentric region of interconnected urban centres in the west of Perak which can compete against the overwhelming city of Kuala Lumpur. The goal of this research is to find this Perak Diamond or to prove the non-existence of the Perak Diamond.

1.5. RELEVANCE

The concept of borrowed size is not new, Alonso (1973) already stated that urban centres could have the ability to augment and compete against each other which in both cases can lead to a discrepancy in the distribution of urban functions. However, it is only recently that there are researchers start to use the concept of borrowed size as derivative for a polycentric function (e.g. Burger et al., 2015 & Meijers, Burger & Hoogerbrugge, 2016). This research will add another document to this relatively new way of investigating polycentrism by using borrowed size and might add new lessons and insight for future researchers who are willing to use a similar approach.

Meanwhile this research also is filling up a gap of current data and knowledge in Malaysia. This research will use new data and a new method to unravel the urban structure of the study area in Perak. This research will sketch a now unknown image of the relations and interconnectedness of the region that is called the “Perak Diamond” and will help policymakers to understand their region to a better extent.

1.6. RESEARCH QUESTIONS

The next questions are formulated to summarize what is explained before:

Main: What can be said about the urban system of Perak on how urban functions in the “Perak Diamond” are distributed, is there a incongruence between the size of a urban centre and its functions, what are the explanations for a possible incongruence and the possible presence of borrowed size or agglomeration shadows in the “Perak Diamond”?

Sub-questions:

1) What is the distribution of urban functions in the Perak Diamond?
2) What urban centres have an incongruity between their size and presence of urban functions?
3) What explains a possible mismatch between the size and function of an urban centre?
4) If a possible incongruence can be explained by the location towards another urban centre, who are the users of the function that is incongruent with the size of the urban centre it is in?
5) What does the urban structure of Perak look like when looking at the urban functions?

This research will start with a general description of the case study area, including some history and other characteristics. Then, in chapter 3, the theoretical framework will be explained, what research there has been done before and how these theories are used in this research. After that the methods that are used to answer above research question will be presented. The last part of this research will be the presentation of all the results following with a conclusion and an answer on the main question of this research.

CHAPTER 2: PERAK AND CASE STUDY AREA

This research revolves around cities of Perak, or rather urban areas of Perak. Malaysian law grants city status (*bandar raya*) by a set of criteria including the size and economy of a local authority (Ministry of urban wellbeing, housing and local government, n.d.) which only defines Ipoh as a city in Perak. Considering this, this research will use the notion of urban area, centre or settlement rather than city. Before going into agglomeration economy, urban scaling, centricity and borrowed size everything starts with a definition of an urban centre.

Meijers, Burger and Hoogerbrugge (2016, p. 181) opened their research with the statement that *"many modern geography textbooks begin with the observation that more than half of the world's population now lives in cities, and the 'urban age' has begun.".* This so-called 'urban age' has also started in Malaysia, figure 11 shows the growth of the urban population in peninsular Malaysia from 1911 to 2000 (Yaakob, Masron & Masami, 2010). The data of Yaakob et al. (2010) also shows that Perak had a total of 2.051.236 in 2000 from which 65,3% lives in settlements with more than 10.000 inhabitants, meaning that Perak scores just above average.

Years	Total Population	Urban Population	Percent of Urban Population	Average rate of growth (percentage per year)		Numbers
				Years	%	
1911[a]	2,339,051	250,790	10.7	1911–1921	4.98	156,980
1921[a]	2,906,691	407,770	14.0	1921–1931	3.41	162,744
1931[a]	3,787,758	570,513	15.1	1931–1947	1.89	359,411
1947[a]	4,908,086	929,928	18.9	1947–1957	6.00	736,372
1957[a]	6,278,758	1,666,300	26.5	1957–1970	4.53	1,296,495
1970	10,439,430	2,962,795	28.4	1970–1980	4.49	1,634,322
1980	13,136,109	4,492,408	33.4	1980–1991	6.68	4,770,030
1991	17,563,420	8,898,581	50.9	1991–2000	4.93	4,827,028
2000	22,202,614	13,725,609	61.8	–	–	–

FIGURE 11 - URBAN POPULATION IN PENINSULAR MALAYSIA (YAAKOB ET AL., 2010)

Throughout the years all research on urban centres uses. different conditions in demarking urban areas, varying from the total number of people to urban density. The question of what urban centres are, is not an easy one (Hirchman, 1976), therefore this research will follow previous research about the Malaysia urban system and use the census of 10.000 inhabitants or more (Hirchman, 1976 and Yaakob et al., 2010). This is also due to practical reasons, as this research uses an urban hierarchy of population in peninsular Malaysia from the National Urbanisation Policy (*NUP) (*Federal Department of Town and Country Planning Peninsular Malaysia, 2016) as a benchmark for the hierarchy of urban functions.

2.1. PERAK: HISTORY AND LOCATION

The State of Perak is located in Peninsular Malaysia, in South-East Asia. It is one of the thirteen States of Malaysia, and the fourth-largest one (DOSM, 2010). It borders Kedah at the North, Penang to the Northwest, Malacca to the West, Selangor to the South, Kelantan and Pahang to the East and Thailand to the Northeast (Figure 2).

Perak is divided into 10 administrative districts (Figure 2), which are further divided into Municipal councils. The State's administrative capital is Ipoh but the Royal capital remains Kuala Kangsar, where the palace of the Sultan of Perak is located (Perak Baseline Study, 2015). In Perak, the signs of the Dutch colonialism, in the 17th Century, and the British Colonialism, in the 19th Century, are still visible to this day in its historical heritage, culture and economy. Favored by a strategic location and abundant natural resources, Perak has historically been benefitting from the tin-ore trading. This advantage was transformed, in Perak's earlier history, into an economic and cultural improvement. Nevertheless, because of the gradual depletion of natural resources and the drop in the price of tin-ore, the once most populous State of Malaysia is now experiencing an economic downturn and a massive manpower drain to higher-growth neighboring states such as Penang, Selangor and Kuala Lumpur (Mooi & Khean, 2007).

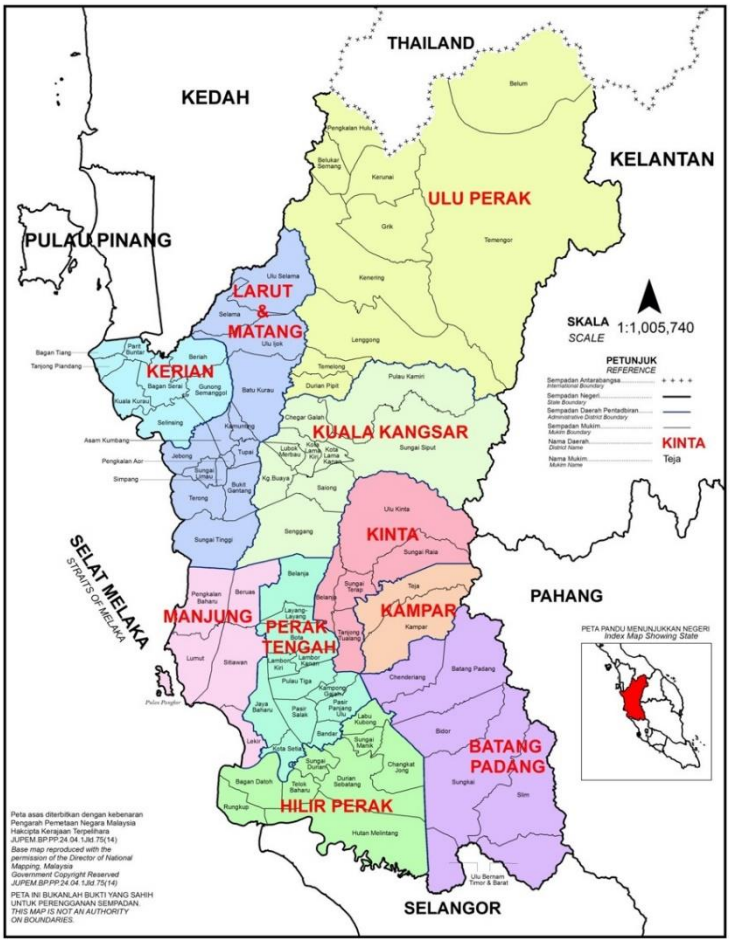

FIGURE 2 - MAP SHOWING ADMINISTRATIVE DISTRICTS AND MUKIM BOUNDARY (DEPARTMENT OF STATISTICS, 2010)

2.2. SOCIO-ECONOMIC FACTS ABOUT PERAK

Perak, in 2019, had a population of 2.51 million inhabitants (DOSM, 2019). The population, alongside with urbanization, has grown in the last 3 decades, but it has not increased at the same pace as other parts of Malaysia. Figure 4 shows the population of the larger urban areas in Perak based on Mukim-level data. When looking at the geographical distribution of its population, it is noted that the majority is concentrated in Ipoh followed by the Taiping-Kamunting agglomeration and the Manjung agglomeration, composed by the cities of Lumut and Sitiawan (Figure 3). Looking at the rank-size distribution of the study area it is shown that this distribution is quite steep meaning that Ipoh is by far the largest with already more than three times more inhabitants than Taiping-Kamunting. Thereafter the differences are getting smaller, but the second and third urban areas are significantly larger than the fourth one Teluk Intan with 100.000 inhabitants. Although the differences look small after that, Sungai Siput has only half the number of inhabitants of Teluk Intan. After that, the distribution gets more linear. The most important observation is that Ipoh has by far the most mass compared to the other cities. For the distribution of functions

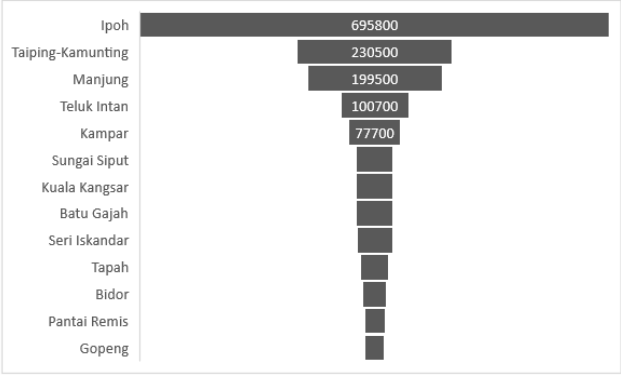

FIGURE 3 - RANK-SIZE DISTRIBUTION OF URBAN AREAS IN PERAK (SOURCE: THESIS DAAN FLORIJN, 2019)

this will be important in the end, because of the size of the city. As shown in figure 5 the imbalance of the city-rank distribution has been increasing between 2000 and 2016 even increasing the difference between cities in Perak.

Urban area (incl direct surroundings)	Mukim	Population		
		2000	**2010**	**2016***
	Ulu Kinta	533027	639512	695800
	Sungai Raia	19094	29706	35100
Ipoh		**552121**	**669218**	**730900**
	Kamunting	24412	36243	42200
	Asam Kumbang	78080	98488	109000
	Pengkalan Aor	30206	37501	41300
	Tupai	31032	35408	38000
Taiping-Kamunting		**163730**	**207640**	**230500**
	Lumut	47628	55590	60800
	Sitiawan	96265	123326	138700
Manjung		**143893**	**178916**	**199500**
Teluk Intan	Durian Sebatang	**77361**	**88695**	**100700**
Kampar	Kampar	**57389**	**69940**	**77700**
Sungai Siput	Sungai Siput	**43385**	**48954**	**54700**
	Kota Lama Kiri	23864	24081	26000
	Saiong	20909	25145	28600
Kuala Kangsar		**44773**	**49226**	**54600**
Batu Gajah - Pusing	Sungai Terap	**39434**	**49095**	**54000**
Seri Iskandar	Bota	**23468**	**43062**	**52600**
Tapah	Batang Padang	**29264**	**33959**	**40200**
Bidor	Bidor	**30389**	**31244**	**34700**
Pantai Remis	Pengkalan Baharu	**28045**	**28832**	**30400**
Gopeng	Teja	**23998**	**26363**	**28400**

FIGURE 4 - POPULATION OF URBAN AREAS IN PERAK (SOURCE: THESIS DAAN FLORIJN, 2019)

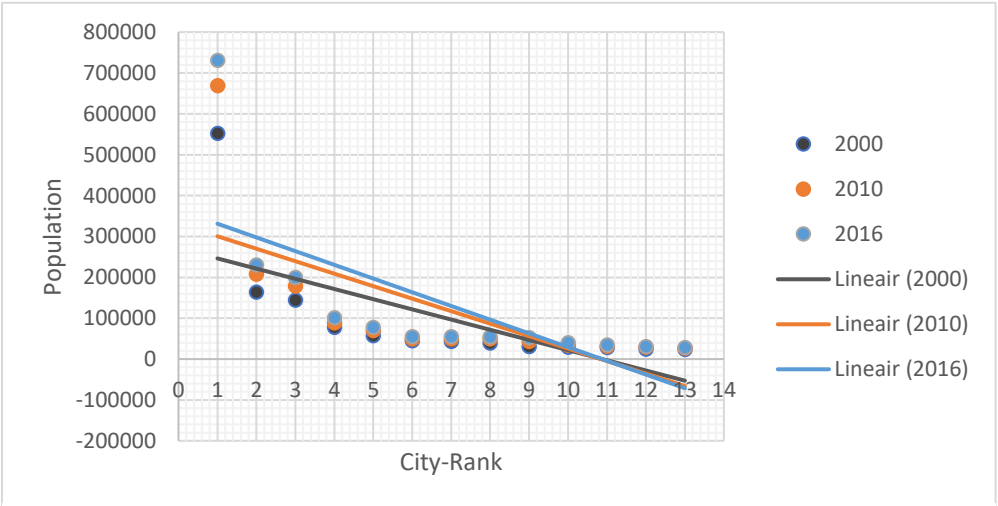

FIGURE 5 - EVOLUTION OF RANK-SIZE DISTRIBUTION IN PERAK (SOURCE: THESIS DAAN FLORIJN, 2019)

The population of Perak is very diverse indeed, Malaysian history is marked by the influence of the Indian and Chinese diaspora. These influences and migrations are still particularly represented through the ethnic distribution of the Perakian population with more than 43% of the population having a non-Malay background (Figure 6). Further, the population of Perak is still young, with a majority individuals younger than 39 years old (Figure 7).

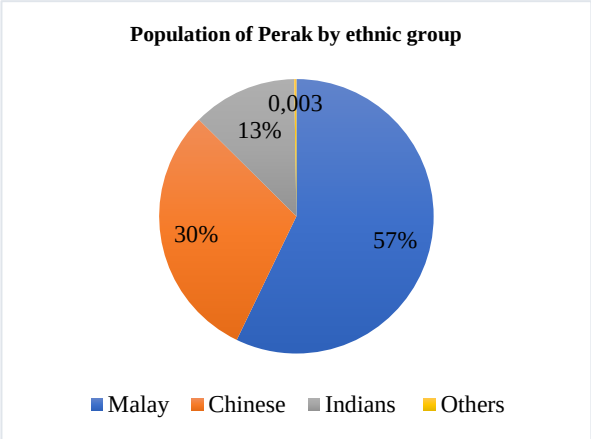

FIGURE 5: ETHNIC DISTRIBUTION IN PERAK (BUREAU OF STATISTICS, 2010)

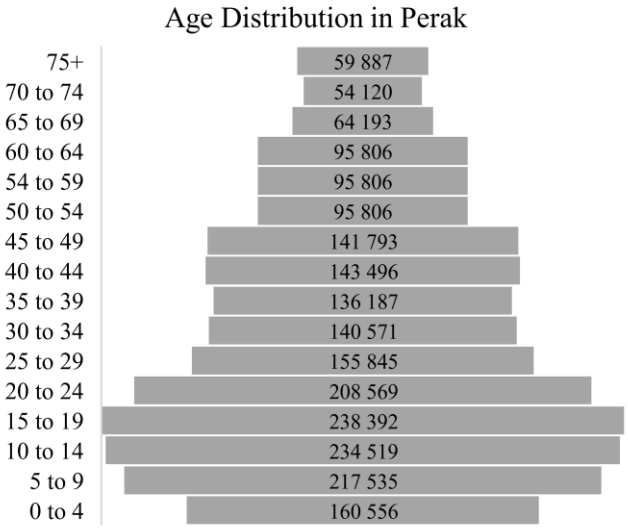

FIGURE 7: AGE DISTRIBUTION IN PERAK (BUREAU OF STATISTICS, 2010)

Perak has a long history as a mining State and it is estimated that close to RM 1billion worth of minerals is generated annually in the State (Perak Baseline Study, 2015). In addition to the mining industry, Perak has an established agriculture and fishing industry. On the geographical side, rubber plantations are found in the central area of the region, Padi is in the Northwest and South and palm oil plantations at the border with Selangor (Draf rancangan struktur Negeri 2040, n.d.). In the last few decades, however, the State has undergone economic structural changes. In fact, during the 1980s and 1990s, manufacturing and services began to replace agriculture and mining as prime economic drivers. Perak also hosts several tourist attractions. Cultural, heritage and natural assets are mainly concentrated in four distinctive clusters: Food, heritage and mining history in Ipoh and its surroundings; maritime attractions in Lumut; archaeological and geological sites in Lenggong; and zoological, botanical and heritage interest points in Taiping (Draf rancangan struktur Negeri 2040, n.d.).

2.3. CITIES OF PERAK AND STUDY AREA

When zooming into the cities of Perak, their profile can be described in terms of administrative, cultural and economic characteristics. In this section, an introduction to a selection of cities is provided to contextualize the geographical boundaries of our case study with a map depicting the case study area (Figure 8).

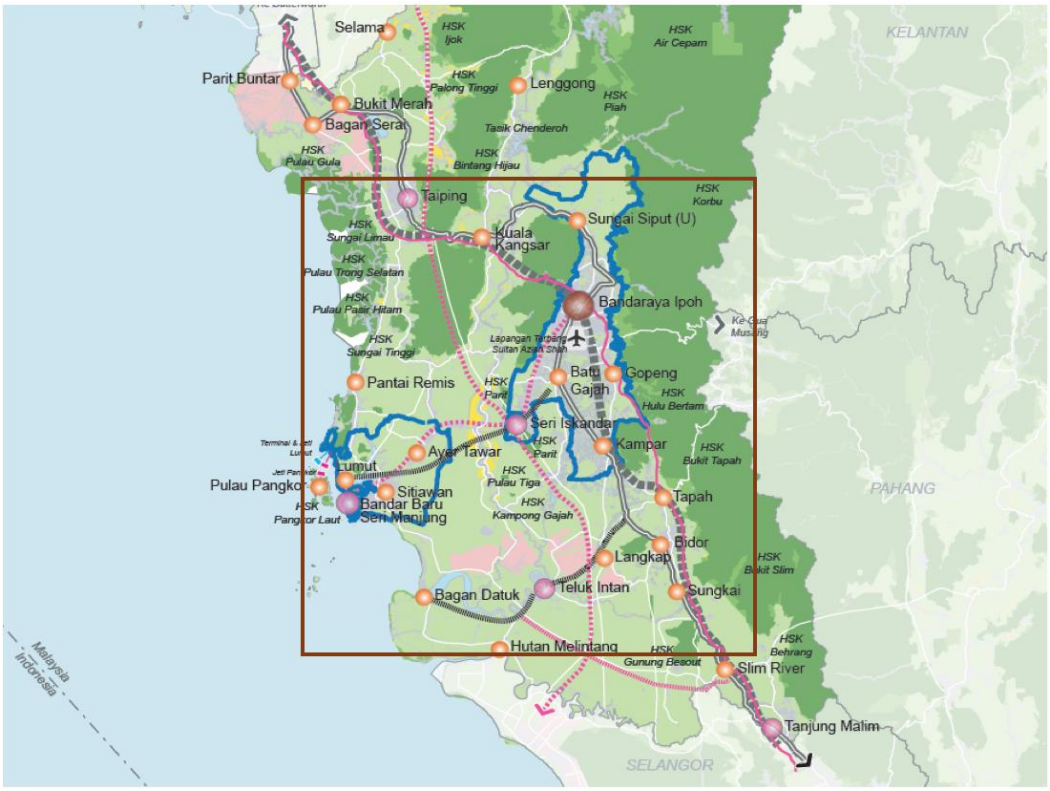

FIGURE 8 - CASE STUDY AREA

IPOH

With a population of more than 700.000 people, forecasted to increase to 800.000 by 2020, Ipoh is the largest urban centre in Perak, and it is recognized in the State Structure Plan as the State capital (Draf rancangan struktur Negeri 2040, n.d.).

Originally a tin mining town, Ipoh is emerging as regional service and manufacturing center. Main functions include public, retail, health and education services. Furthermore, the city specializes in E&E, fabricated metal products, natural resources, machinery and transport equipment. As anticipated in the Infrastructure sub-chapter, Ipoh also hosts the only inland port in Perak. Looking at current and future economic development, The Ipoh Local Plan promotes a multi-nucleus urban structure featured by a commercial town center, aviation industry to the South, tourism oriented area to the East, an industrial and a high tech center to North and heavy industry in the East (Perak Baseline Study, 2015).

KAMUNTING AND TAIPING

Taiping is the second largest urban center in Perak with a population of somewhat more than 230.000. It is recognized in the State Structure Plan as district capital. Other than a district level administrative, services and commercial center, Taiping is featured by heritage, culture, tourism, recreation and education assets serving as supplementary functions ((Draf rancangan struktur Negeri 2040, n.d.). Kamunting, located in vicinity of Taiping, hosts one industrial estate mainly focused in rubber products. Looking at current and future development plans, Kamunting is the subject of a Blueprint by the Perak Economic Planning Unit that aims at revitalizing its service and manufacturing sectors, as well as infrastructure and education (NST, 2017)

LUMUT-SITIAWAN

Lumut-Sitiawan is recognized in the State Structure Plan as district capital (Perak State Structure Plan 2040). Lumut, alongside Ipoh and Taiping, is among the most important urban centres of Perak. Its main asset is recognized in the secondary port and bulk terminal, which includes a ship building and repair industry (Perak Baseline Study, 2015). The town itself is relatively small, but there are significant industrial and residential hubs located in the Northern and Eastern periphery (Malaysian Department of Statistics, Data Bank, 2012), including Sitiawan, with a population of approximately 200.000. Surrounding agriculture is centred on palm oil plantations and industry includes oil and gas, manufacturing, iron-ore distribution and ship building.

KUALA KANGSAR

Kuala Kangsar has a population of approximately 50,000 and is the Royal capital of Perak. In the State Structure Plan, it is defined as a high order local centre. Other than being a district administrative centre, it is identified as a relevant hub in terms of higher education, higher order commercial services, tourism and industrial hub specializing in food, agricultural and timber products (Perak State Structure Plan 2040). Also, Kuala Kangsar's relative importance is associated with its role as gateway to the region.

SERI ISKANDAR

Seri Iskandar has a population of approximately 50.000 residents. It is known for its role as higher education centre, characterized by a high proportion of institutional land use. As a matter of fact, it hosts the MARA University of Technology, Kolej Profesional MARA Seri Iskandar, Institute Kemajiran Belia Negara and the University Technology Petronas (Perak Baseline Study, 2015).

2.4. PERAK IN MALAYSIAN POLICY

There are several large plans in Malaysian policy, the NUP has already been mentioned a couple of times and a couple of other examples are the National Physical Plan 2 and 3 (NPP), Perak 2040 and the Tenth Malaysia Plan. This section will explain the policy of Perak state to create a base understanding of the situation. In combination with the findings in chapter 2 & 3 some expectations can be made for the outcome of this research.

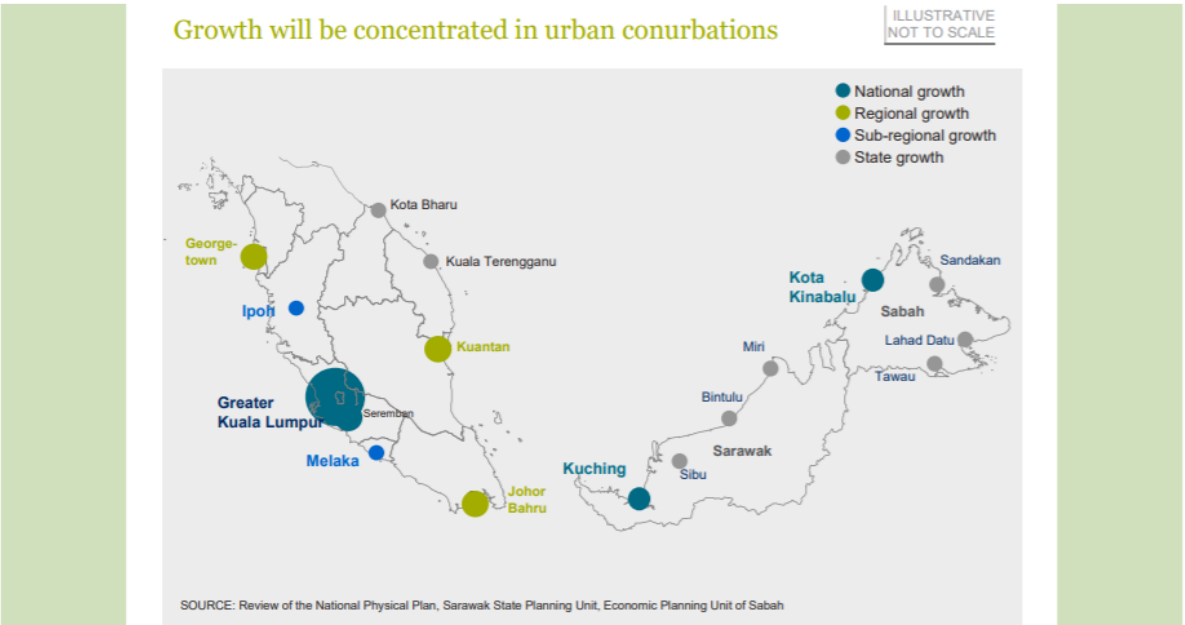

FIGURE 9 - GROWTH WILL BE CONCETRATED IN URBAN CONURBATION (TENTH MALAYSIAN PLAN)

Going through the different policy documents there is a clear direction towards urban development (NUP, NPP, Tenth Malaysia Plan) which *"shall be based on the urban hierarchy"* (NUP-2, 2006 p. 37). Figure 9 shows an image taken from the Tenth Malaysian Plan, implying that growth in Perak should only be concentrated in Ipoh. Looking at the National Physical Plan there is also a strong emphasis towards the hierarchical policy that seems to be strongly embedded in Malaysian policy. When going through this document almost every policy strategy is based on the hierarchical structure, and the connection between (minor and major) settlement centre towards the (growth) job centres.

This is the image shown by the national structure plans, when looking at the Perak 2040 plan there is no real difference. Although the illustrations show possibilities in other cities and strengths and opportunities are offered, the main focus is on Ipoh. Figure 10 shows a map taken from the Perak 2040 plan and clearly shows that Ipoh is the centre of the state.

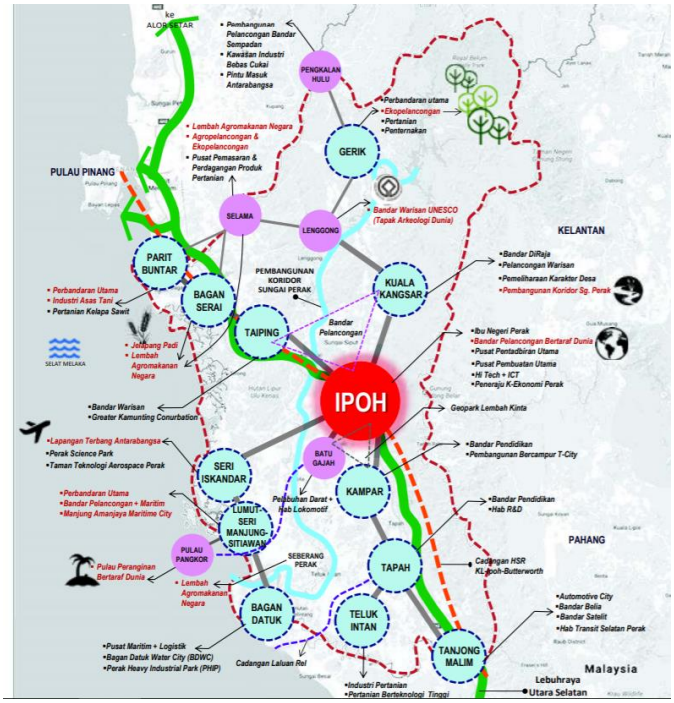

FIGURE 10 - MONOCENTRICITY IN PERAK? (PERAK 2040)

3.THEORETICAL FRAMEWORK

In the first chapter the aim of this research is made clear, in the second chapter the geographical context of the study area is discussed. This third chapter is the theoretical framework of this research, split up in two sub-sections: Theory and Malaysia. The first section will explain the theoretical framework in which this report is written and that can be used to answer the research questions. The main goal of this chapter is to explain what the connections between the distribution of urban functions and polycentricity is. The theory leads to a set of scenario's which can be the end result of this research. In the end of this chapter the conceptual model will be presented which will show how the theories fit in this research and how these theories will lead to the result of this research.

3.1. THEORY

3.1.2 AGGLOMERATION EXTERNALITIES AND URBAN SCALING

Researchers in the field of economic geography agree that agglomeration leads to economic benefits: agglomeration externalities (de Groot, Poot & Smit,2009). However, there is an ongoing discussion about the explanation of urban growth. There are two driving theories that explain agglomeration economy: Marshall (specialisation) and Jacobs (diversity) (Van der Panne, 2004). Both theories are fuelled by earlier research of Porter (competition) and Beaudry and Shifffauerova (2009, p. 320) that define an externality as "*an effect emanating from one activity that has consequences for another activity, but is not directly reflected in market prices".* A concept that is often brought forward when discussing agglomeration externalities is knowledge spillover (Beaudry & Schiffauerova, 2009; Frenken, van Oort & Verburg, 2007; de Groot et al., 2009) which is defined as geographically bounded new economic knowledge that increases to stock of knowledge available for each individual firm in a region. While most studies about agglomeration externalities are concentrating on more efficiency and economic growth, there are also studies that prove that agglomeration leads to so-called static externalities; density and scale of agglomeration can explain the distribution of amenities (Glaeser, 1992). This research is not aiming to take a position in the discussion between specialisation and diversity of agglomeration economies In the light of this research it is important to understand that the process of agglomeration of mass of people and economy in cities leads to the emergence of more and higher-level amenities at both intra- and inter-urban level.

Another theory concerned with the size of cities and the distribution of amenities is the law of urban scaling (Pumain, Paulus & Vacchiani-Marcuzzo, 2006). Scaling refers to a set of properties associated with a type of complex systems, which manifest nonlinear relations, often formalised as power laws (Pumain, 2004). Essentially, power laws studies revolve around a simple bivariate regression of population numbers against another variable such as amenities or an economic variable such as the number of patents for a number of cities. The urban scaling law follows up on settlement size-hierarchy and city rank-size distribution (Ortman, Cabaniss, Sturm & Bettencourt, 2014). Settlement size-hierarchy is used to predict the functional hierarchy in terms of services in a city, linking the city-size to the distribution of functions. Size rank-size distribution uses Zipf's law expressing a regularity between city size and its rank (Pumain, 2004), meaning that the size of each second city is half of the size of the former. The term urban scaling refers to the scale of a city which relates to the properties of the system – the city. And Bettancour, Lobo, Strumsky and West (2010) state that power law scaling manifests in a super-linear metric, meaning that some properties grow disproportional with population size. Figure 12 shows an example of such metrics for the United States, however there are some differences in the results for France and the United States (Pumain et al., 2006). Despite Pumain et al. (2006) state that these deviations can be explained by differences in nomenclature and that the results are quite similar globally. This research will not assume that the same can be considered for cities in Perak. The most important conclusion that can be drawn in the light of this research is that the hierarchical ranking of cities can be related to the properties in a city. This research will use a hierarchical classification of cities and a hierarchical classification of functions to find discrepancies between both entities. Therefore, it is necessary to know that there is scientific proof of the hierarchy of cities and the distribution of urban functions or amenities, whether that distribution is super-linear or not.

United States			France	
Sector Number*	Name (NAICS)	β	Corresponding NES sectors**	B
22	Utilities	1.01	G1-G2	0.84 to 1.13
23	Construction	1.05	H0	0.98
31	Manufacturing	0.97	C1--F6	0.86 to 1.40
42	Wholesale trade	1.19	J2	1.07
44	Retail trade	0.95	J1-J3	0.95
48	Transportation & warehousing	1.19	K0	1.09
51	Information	1.21	N1 (partial) C2	1.10 to 1.17
52	Finance & insurance	1.22	L0	1.11
53	Real estate & rental & leasing	1.18	M0	1.19
54	Professional, scientific & technical services	1.30	N2 (larger)	1.15
55	Management of companies & enterprises	1.52		
56	Admin, support, waste mgt, remediation services	1.20	N3	1.02
61	Educational services	1.23	Q1	0.97
62	Health care and social assistance	0.95	Q2	0.99
71	Arts, entertainment & recreation	1.14	P2	1.10
72	Accommodation & food services	0.98	P1	0.99
81	Other services (except public administration)	1.03	P3	0.95
95	Auxiliaries (exc corporate, subsidiary & regional mgt)	1.48		
	"Research and development"	1.54		1.67

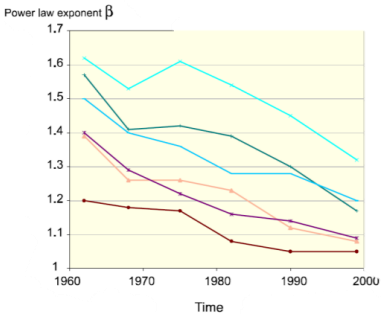

FIGURE 12- POWER LAW SCALING METRICS AND DIFFERENCES BETWEEN FRANCE AND US (PUMAIN ET AL., 2006)

3.1.3 DISTRIBUTION AND USERS OF URBAN FUNCTIONS; CENTRAL PLACE THEORY

Christaller created the Central Place Theory in 1966, and lists a set of regularities that refer to a positive correlation between the total population (city size) and the number and variety of urban functions (Pumain, 2004). In other words, Christaller's theory can be used to explain a hierarchy of goods or services or as they are referred to in this research; urban functions. A central place is a settlement which provides services and goods for the population living around it. The theory then distinguishes low order functions (e.g. supermarkets) and high order functions (e.g. universities). A settlement that has high order functions implies the presence of low order functions, but not the other way around. Settlements can be distinguished in different orders of settlements as represented in figure 13. There are two concepts on which this theory relies: threshold and range. The threshold is the minimum amount of people (population) that is needed for having a particular good or service, and the range is the maximum distance people are willing to travel for these goods (Agarwal,2007). The outcome of these costumer preferences are central places that have the highest order functions, because there is access to the most people within the shortest distance. In other words, the Central Place Theory generalizes an urban functional hierarchy regarding spacing, size and functions of settlements.

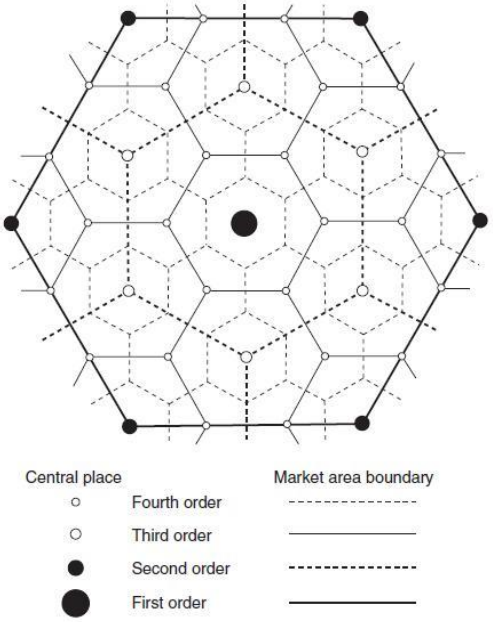

FIGURE 13 - CENTRAL PLACE THEORY (CHRISTALLER, 1966)

Because of the static character and a number of assumptions that are made in the Central Place Theory there is some criticism on the Central Place Theory. Some assumptions pertaining to Christaller are: there has to be an isotropic surface, an evenly distributed population, evenly distributed resources, equal transportation costs, the use of the same transport modality, perfect competition and consumers have similar purchasing power. These assumptions ensure that the emergence of a situation as shown in figure 13 does not exist in the real world. However, even though the Central Place Theory cannot be applied in realistic situations, the research was a breakthrough in the understanding of hierarchical development of regions. Heilbrun (1987) wrote *"A hierarchy is by definition a systematic arrangement of the classes of an object. In this case the object is economic centres, large and small. The central place hierarchy provides a description of the relationship between a central place--higher order place--and its tributary areas--lower order places. Once this hierarchy is pointed out, anyone can see it."*. In other words, this means that the highest order functions are found in the cities with the highest number of people and the cities that are most central in terms of infrastructure and connectivity. In the case of the study area in Perak, this would mean that the highest order functions are found in Ipoh. In terms of functional centricity, the central place hierarchy is evidence for a monocentric system; the highest order functions are in the most central place and the smaller and less central the place is, the lower order functions there are if the system looks like the Central Place Theory. Because the central place theory also implies that lower order functions are found next to high order functions but not the other way around. It means that people travel from the periphery to the centre, but not the other way around. Therefore, in order to speak of a polycentric urban region, there have to be higher order functions in the city than expected by their hierarchical position. This

concept of cities capturing certain functions using the mass of a larger urban area is called borrowed size and is often invoked in discussions about polycentricity. In the next section borrowed size will be explained, how it can be used to measure centricity and how borrowed size itself can be measured.

3.1.4. CENTRICITY

While the previous theories of economic geography focus on a more traditional argumentation using agglomeration externalities, it is getting more common to think of regions as functional urban area's (FUA's) (de Goei, Burger, van Oort & Kitson, 2010). A polycentric approach is gaining interest by several policymakers and researchers (Masip-Tresserra & Jaume, 2016) because of the ability to grasp agglomeration externalities with this spatial configuration. This research is revolving around the functional urban system and possible polycentricity in the state study area within Perak, rather than the performance of its individual cities. As seen in the introduction, the Perak Diamond has been proposed to be an integrated inter-urban functional urban area. The urban system as a set of interdependent cities can vary from a fully monocentric to a fully polycentric structure (de Goei et al., 2010). Within these concepts there are several different approaches. In most of the research there is a distinction between a morphological and functional (or relational) approach of poly- / monocentricity (de Goei et. al, 2010; Meijers, 2008; Seymour, 2017). The morphological approach measures the relative weight of cities by for example population or economic indicators (Li, Zhou, Zhang, Cheng & Zu, 2017), while the functional approach measures the nature of the interaction between centres (e.g. commuting or firms) (Seymour, 2017). There are some ongoing discussions about the preference for a monocentric or polycentric system. In the literature, e.g. that there are less diseconomies in a polycentric urban region (Meijers, 2008). Since the aim of this research is evaluating Perak's urban system and assessing whether the region is polycentric (Perak Diamond) there will be no discussion about the pros and cons of polycentricity in this research.

MONOCENTRICITY

Monocentricity refers to a system with a central unit surrounded by residential areas in which most economic activity takes place in the centre of the system. The relationship of a monocentric model is hierarchical and most commuting flows are directed to the urban core (de Goei et al., 2010) as presented in figure 14. The figure shows a monocentric model, where all flows are directed towards one centre, there is a clear hierarchy and there is no interdependency between cities at the intra-urban (local) or inter-urban (regional) scale (de Goei et al., 2010). The centre in this case is the place that provides services and jobs, while the hinterland provides the people. This leads to one-directional flows of people towards the centre in one city. This theory is based on one city, however there is no real-world example found where there are complete regions where there are multiple cities in which only one city has amenities or jobs. A monocentric region in this case would mean that there will be a strict hierarchy based on size, functionality and firms presented in a whole region. Specifically regarding amenities, a monocentric system will be found when there is a clear hierarchy in amenities for the specific size of each city, when there are higher-level amenities found in smaller cities there is borrowed size (Meijers, 2008) which will be explained in the next section. The presence of borrowed size and agglomeration shadows will lead to multidirectional flows of people, while a hierarchical distribution of amenities will only lead to flows from the smaller cities to the larger.

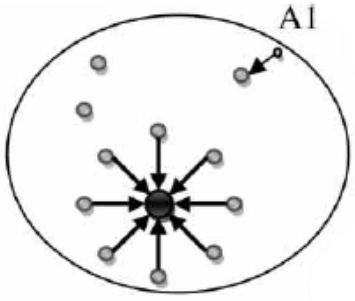

FIGURE 14 - A MONOCENTRIC CITY (DE GOEI ET AL., 2010)

POLYCENTRICITY

Polycentricity on the other hand refers to a situation where other cities emerged into centres and have their own amenities and demand for labour (de Goei et al., 2010) creating incentives for flows to go back and forth. De Goei et al. (2010) start with explaining the emergence of these centres within the boundaries of one city, describing a polycentric city. In the context of this research the polycentric urban region is central: *"an urban network of historically and spatially separate metropolitan areas comprising a region"* (de Goei et al., 2010; figure 15In his research, Meijers (2008) states that certain amenities need a considerable market size; a certain population. In a polycentric urban region, it should not matter in which area a function is, the presence of

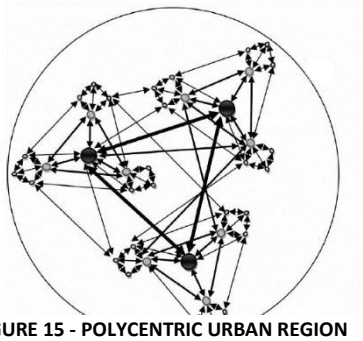

FIGURE 15 - POLYCENTRIC URBAN REGION (DE GOEI ET AL., 2010)

connectivity can be utilized by the population on regional level. A polycentric urban region is characterized by different urban centres which are separated and show their own speciality. Meaning that in terms of urban functions, each separate city will have functions on the hierarchical level for the population of the whole region and these functions are spread across the region in several specialised centres.

MORPHOLOGICAL VS FUNCTIONAL APPROACH

Measuring polycentricity can be done in several ways, two frequently used approaches are the morphological and the functional approach. Morphological polycentricity analyses the physical attributes of a region (de Goei et al., 2010). This approach often uses methods like rank-size distribution or built-up areas by comparing the centres in the study area and see how the physical structure is distributed. Using this approach, a more equal distribution of physical attributes will mean a more polycentric urban region. The functional approach of polycentricity analyses the relationship between urban centres (de Goei et al., 2010) and uses commuting flows, firms or amenities to evaluate the system. This research applies a more functional approach, similar to previous research on urban functions. The region is polycentric if there is a common pool of people in the region for all urban functions, it does not matter where people live to use the function, and this is represented in functions that are carried by the complete mass of the region instead of functions that can be hosted by the mass of the size of the separate urban areas on their own. This research looks especially similar to the research on borrowed size and polycentricity in Europe by Meijers et al. (2016). In this research the distribution of metropolitan functions in a region is also used as indication for the urban system.

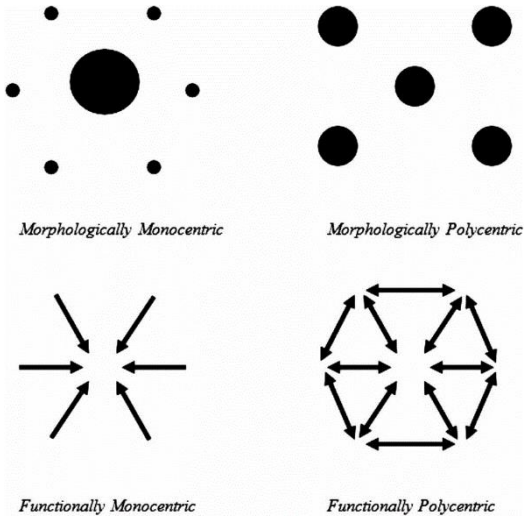

FIGURE 16 - MORPHOLOGICAL VS FUNCTIONAL CENTRICITY (BURGER & MEIJERS, 2012)

3.1.5 BORROWED SIZE AND AGGLOMERATION SHADOWS

As said before, borrowed size is a concept that is often invoked in discussions about the urban patterns and dynamics in regional urban systems (Burger et al, 2015). The concept of borrowed size is introduced by Alonso (1973) and can be defined as: *"the situation in which close-by and well-connected cities host urban functions normally found only in larger cities, such as top-level urban amenities, because the support base is larger given the proximity of more cities"*(Meijers, 2008, p. 2325). The central place theory stated that high-order functions need a minimum amount of population mass and centricity. This is confirmed by Capello: *"The limit that the medium-sized cities come up against, and which often makes them succumb vis-à-vis the great metropolis, is the limit of critical mass and centrality"* (Capello, 2000, p. 1926). In addition, Alonso also suggested that smaller urban areas did not only borrow agglomeration externalities from their neighbours, they also avoid the costs of agglomeration (Meijers et al., 2016).

Borrowed size occurs when agglomeration externalities are regionalised due to the presence of several interconnected urban centres (Brezzi & Veneri, 2015). In other words, cities can compensate a possible relative lack in size by being embedded within a network of cities causing agglomeration externalities to turn into or being complemented with network externalities (Meijers et al., 2016). Where agglomeration externalties are restricted to the area within the demarcation of a city, netwerk externalities suggest that these externalities are shared wihtin a interconnected region (Parr, 2002). The rapid growth of connectivity in the past decades has increased the importance of network externatlities (Meijers et al., 2016). While most studies in recent time focus on the positive sides of network externalities there is another side of the medal as well; agglomeration shadow (Meijers et al., 2016). *"Although smaller places can potentially host urban functions that are normally only found in larger cities through this process of borrowing size, increased spatial competition between nearby places can also lead to a situation in which a place hosts fewer functions than it could normally support."* (Burger, 2015). However, the smaller settlements that are in the shadow of a large neighbours will have access to the agglomeration benefits of the larger neighbour and this creates an expecting growth in the smaller cities (Meijer et al., 2016). Or as Alonso said: *"While they retain many advantages of smaller size, such as lower levels of congestion, they enjoy advantages of larger size through their easy access to other centres. Their people can use the shopping and entertainment facilities of other cities to complement their own, their businessmen can share such facilities as warehousing and business services, and their labour markets enjoy a wider and more flexible*

range of demand and supply" (Alonso 1973, p.200). This means that the concept of 'size' in borrowed size does not precisely capture the process.

This is why Burgers & Meijers (2017) made a distinction between 'borrowed function' and 'borrowed performance' which is shown in figure 17. The former is described as a higher-level functionality of a city in terms of functions; smaller cities that host higher order functions. The latter describes the allowance of a better performance of a city within proximity to other cities and embedded in a network. Although borrowing functions increases the likelihood of borrowing performance, which can be backed up by research of Brueckner Thisse & Zenou (1999). The example of cities growing while in the agglomeration shadow of a large neighbour shows the opposite. In Burger & Meijers' (2017) research the combination of both borrowed function and borrowed performance is called borrowed size and the combination of performing less and hosting less functions is called an agglomeration shadow. This research revolves around the distribution of urban functions in the study area of Perak and focusses more on borrowed functions rather than measuring borrowed performance due to practicalities (e.g. the availability of data on performance).

Dimensions of borrowed size		Connection size ←→ function	
		Less functions than expected given size	More functions than expected given size
Connection size ←→ performance	Performs less than expected given size	*Agglomeration shadow*	*Borrowed function*
	Performs better than expected given size	*Borrowed performance*	*Borrowed size (function & performance)*

FIGURE 17 - BORROWED FUNCTION AND BORROWED PERFORMANCE (BURGERS & MEIJERS, 2017)

BORROWED SIZE AND POLYCENTRICITY

Something that has already been touched upon, but still important to mention as it is the central theme of this research is the relation between borrowed size and polycentricity. In the previous section of this research it was pointed out that the hierarchical distribution of functions is characterizing a monocentric region. In research about borrowed size and network externalities the main condition for these processes to occur is a system of interconnected cities or urban centres (Brezzi & Veneri, 2015). Going back to the definition of a polycentric region: Separated urban centres that are interconnected and function as a singular unit (Seymour, 2017). This would mean that if smaller cities are hosting higher order functions and therefore borrowing size from higher order functions there has to be a connection between the smaller city and the larger city; which means that both cities function as a singular unit; which is proof for polycentricity. Figure 18 presents the correlation between size and functions of a city for all European cities in countries with 10 or more agglomerations (van Oort, Meijers, Thissen, Hoogerburgge & , Burger, 2015) and this figure shows a disconnection between the functions and size in polycentric system (r=0,686) in comparison to cities in monocentric countries (r=0,943). This proves that borrowed size is observed more often in polycentric areas. However, contradictory to Alonso's theory (1973), van Oort et al. (2015) state that the likelihood that a city borrows size in a polycentric region is higher when the city is bigger (>400.000 population), while smaller cities (<150.0000) in a polycentric region are more likely to have an agglomeration shadow. In their research, van Oort et al. (2015) also compare integrated cities with isolated cities and they conclude that integrated cities (FUA) borrow more size in comparison to isolated cities. This does not mean that isolated cities perform negatively, due to the absence of competition there is also a positive effect of borrowed size in isolated cities.

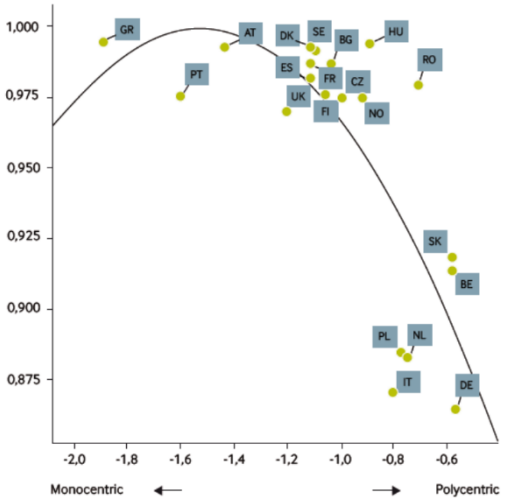

FIGURE 18 - BORROWED SIZE IN POLYCENTRIC VS MONOCENTRIC COUNTRIES (VAN OORT ET AL., 2015)

MEASURING BORROWED SIZE

When smaller cities exhibit characteristics of larger cities this is called borrowed size. For the distribution of functions this would be the case if smaller cities host urban functions that are distinctive for cities of a higher

order in hierarchy *AND* this discrepancy is caused by the position of the smaller city towards the larger city (van Oort et al., 2015). Research on borrowed size therefore always consists of two parts: the presence of metropolitan functions and a contextual research on location and connectivity (Meijers, 2008; Burger et al., 2015; Meijers et al., 2016; Meijers & Burger, 2017). For example, Burger et al. (2015) examine the disconnection between the size of a place and the occurrence of cultural amenities and examine to what extent this place is embedded in a FUA (location) and the (national and international) accessibility of the place (connectivity). In other words, to measure borrowed size there is a weight needed for the urban functions which states which order in the hierarchy these functions has and there have to be users from a greater urban area that make use of the urban function. After all, borrowing a function is also borrowing a mass of people, meaning that users of the urban functions do not only come from the respective urban area but from a larger extent. While Christaller used to say that lower order urban areas have lower functions, because the mass of people is too low to support higher order functions and functions of the highest order use the highest mass, in a polycentric urban region, the whole region acts as one entity, meaning that all people in the PUR are users of all functions in the region. So, it does not matter which urban centre an urban function has, connections are good enough for smaller urban centres to host higher order functions.

3.1.6 SCENARIO'S

Based on previous theories there are three scenarios' conceivable as a result for this research: polycentricity, monocentricity and archipelago. This section will present which findings of urban function indicates each particular scenario.

SCENARIO 1: POLYCENTRICITY

Borrowed size is an indication for the integration-level of an urban region (van Oort et al. 2015). If there are functions found in cities that exceed the level of hierarchy of the city this is an indication for borrowed size. However, if the presence of the function cannot be related to the position of the city towards other cities, but rather to other locational factors (e.g. physical location or strategic position), the location cannot be explained due to borrowed size and there is no proof for polycentricity. In other words, the finding of higher-order functions than the hierarchical position in a city, combined with the finding of a user-base that is from other cities in close proximity will indicate a complete functional region at inter-urban level (de Goei, et al.,2010) and therefore polycentricity. Because the user-base is from a larger area, there is no need for certain functions to exist in the cities where the users are from. In other words, there also have to be cities that are in the agglomeration shadow of another city and do not have functions that fit to their hierarchy, but then in negative sense. In this case there will be cities with a specific specialism in a certain field, meaning that there will be commuting in the functional urban area in order for the complete mass of people of the urban area to make use of the highest order function rather than that the highest order functions being all found in one place. Functions that use the mass of the whole study area will be an indication for this outcome. In other words, if Ipoh would host functions that are national metropolitan functions, this will be an indication of a polycentric urban region because there will be a common pool of users in the whole urban region of the study area.

FIGURE 19 - SCENARIO 1 : FUNCTIONAL POLYCENTRICITY (OKRASZEWSKA ET AL. 2019)

SCENARIO 2: MONOCENTRICITY

A perfect distibution of urban functions according to the hierarchy will indicate a monocentric system. This would mean that there are no or barely any higher-order functions in smaller cities and no functions in the whole system that are expected to be found in larger cities or metropolitan areas. In this case the largest city will still have the highest order functions and looking back at Christaller's theoy on central places this would mean that the lower-order cities within the hierarchy are also users of functions in the largest city. The relations are all from smaller cities with lower-order functions to larger cities with higher-level functions. In short this scenario will be the result of all urban functions that are

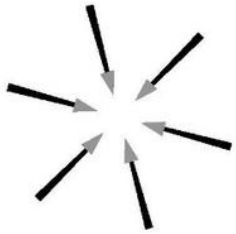

FIGURE 20 - SCENARIO 2 : FUNCTIONAL MONOCENTRICITY (OKRASZEWSKA ET AL. 2019)

found are distributed according to the size of the urban centres, there will be no functions in the whole urban system that are typical for cities like Kuala Lumpur and Georgetown. All highest ordern function will be in Ipoh, the state capital, but in Ipoh are no higher order functions.

SCENARIO 3: ARCHIPELAGO

The definition of an archipelago is not necessarily described in theories, but it can be explained as the situation in which the urban system that has several isolated urban areas that are not connected, as separate islands in an archipelago. Van Oort et al. (2015) prove that isolated cities also show some extent of borrowed size, because of the absence of competition. Therefore, an archipelago structure will be indicated if there are urban functions found that are of a higher-order hierarchy, without the presence of agglomeration shadows in other cities. An isolated city is defined by Van Oort et al. (2015) as a city that is beyond the 45-minutes isochrone, so when there are cities found that are not well-connected and show higher order functions this will hint that these cities are excluded from both a polycentric as a monocentric system.

3.2 CONCEPTUAL MODEL

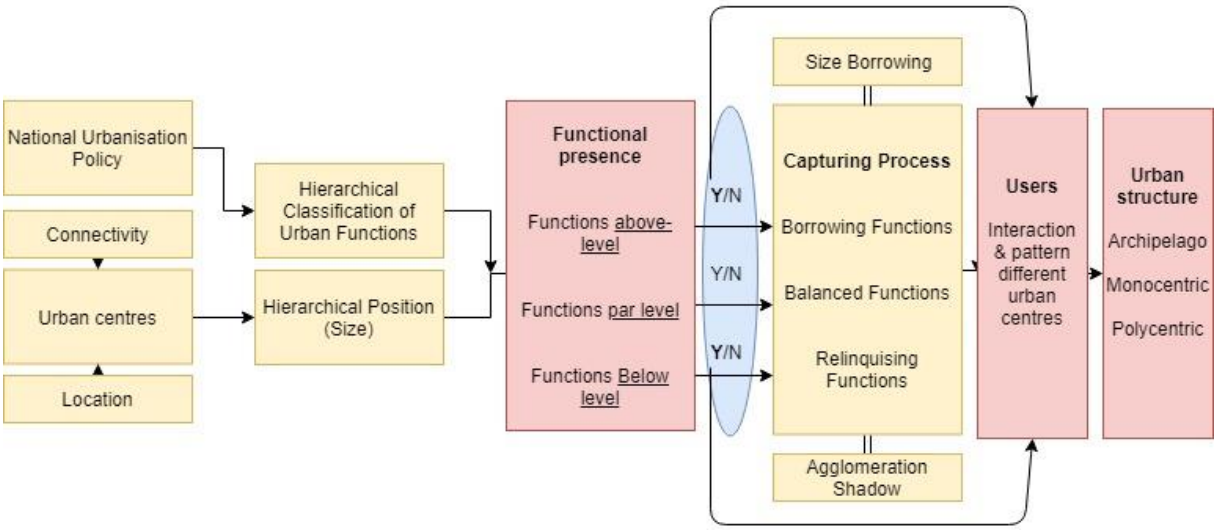

FIGURE 21 - CONCEPTUAL MODEL

In order to research the borrowed size there has to be a framework with urban functions with respect to the size of urban centres in Malaysia. This research will specifically use the hierarchical classification of urban functions from the National Urbanisation Policy for the respected size of the urban centre to evaluate which cities have functions that do not match with their own hierarchical level. The configuration and aggregation of this framework will be explained in the next chapters. For each urban centre and each sector of urban functions there can be an above-level, par-level or below-level score. A score that is not par-level might indicate borrowed size or agglomeration shadow, as described in the literature. However, just a mismatching score is not the only condition for borrowed size or agglomeration shadow, the literature adds that this mismatch has to be a explained by the location of an urban centre towards another urban centre. The mismatching functions therefore are further investigated before concluding anything about the urban structure of the system. The next chapter will explain the method of data-collecting for both parts of this research.

4. METHODOLOGY

This research can be divided into two parts that belong a different methodology: distribution of urban functions and the users of urban functions. The first part revolves around the first condition for borrowed size: the presence of higher order function in smaller order urban centres (or the absence of functions in an urban centre). In the second part it will be investigated what the explanation of the inconsistency is and if the function might locate itself in a smaller urban centre because of a size borrowing process. Therefore this research uses two different methodologies, starting with a more qualitative approach of collecting data on the hierarchical position of function in cities and explaining the meaning of these functions in the urban regional system to a more qualitative approach of counting the users of mismatching functions. This research needed the next six steps to give an answer on the question which scenario applies the best to the Perak region and how the Perak urban structure looks like. These steps are as follows:

1) Create a hierarchical framework of urban functions for Malaysia
2) Make an inventory urban function
3) Compare the hierarchy of urban functions with the hierarchy of the urban centres
4) Analyse the scores over whole Perak (borrowed size and agglomeration shadow)
5) Analyse findings per sector (cause of mismatch)
6) Survey on the users of urban functions
7) Analysing possible “flows of borrowed size”

A mixed method approach was chosen for this research, combining both qualitative as quantitative research. The approach uses hierarchical classified functions in the urban areas and compare whether these functions fit to the hierarchical size of the function. After that the functions are analysed using descriptive information and quantitative information in the form of surveys to decide the catchment area of these functions and a possible integration with other urban areas. How this works is explained in this chapter.

4.1. HIERARCHICAL FRAMEWORK

There are several theories that explain why urban functions are distributed hierarchically across all urban areas; lower order functions in smaller urban areas and higher urban areas with larger metropolitan function. The highest order functions need the most mass in terms of people to be able to exist and therefore locate themselves in places with the most mass also serving smaller centres. This research however is probing for functions that are incongruent with the size or mass of urban centres in the study area. In order to be able to say what functions are incongruent with the size or mass of an urban centre it is needed to know what the hierarchical distribution would be. As stated before, the Malaysian government has a strong focus on hierarchy and also made a list of urban functions that belong to the size of each of the seven urban hierarchies. The complete table of this allocation is found in appendix I, however this list was not necessarily completely useful, therefore a “translation” of this table has been made in the first part of this research, which will be explained in the next chapter.

4.2. AN INVENTORY OF URBAN FUNCTIONS

To get a comprehensive overview of all urban functions within all sectors a quite extensive and precise way of working was needed, where several sources were used. The sources of this inventory are listed in figure 22 for each individual sector of urban function. Because this research is investigating what functions are above-level or what functions on a level are relinquishing there is no need to find all single urban functions, but it is needed to find functions that are indicators for a certain level of urban hierarchy. For that reason the table of the NUP is translated into a matrix with indicators in each sector of urban hierarchy, the advantage of this matrix is that it makes it easier and more accessible to search for functions other than those for the order of the urban hierarchy. Furthermore, the original table from the NUP has a disadvantage of several functions that appear across several hierarchies, which means that such a function is not necessarily an indicator for the highest order hierarchy. For instance a government hospital is found in a national growth conurbation, but also in a major settlement centre and everything in between. In the indication matrix that is used in this research this would mean that a government hospital is an indicator for a major settlement centre, which means that only a minor settlement centre is able to score above-level in this category. Meanwhile the absence of a functions on a lower-level order in a higher hierarchical urban centre is never neglected in this analysis, meaning that data on all order functions are collected in this research. This matrix is used for the first two steps of this research and is used to

operationalise the data that is found. With the help of the matrix it is easy to compare the data of the location of urban functions to the size of the urban area, which is needed to answer the first question of this research.

So in the matrix all urban functions that are subject to this research are listed, this means that the presence of these functions in the urban centres of this study have to be collected. The first step was to approach local governments, because they might use the same framework as the NUP to keep a list with all urban functions. Unfortunately there was zero or negative response upon this request. This meant there was no complete list of all functions available, but there are still plenty of sources that could be and are used to get a comprehensive overview of the functions in the study area. Because the search was mainly to a lot of high-order metropolitan functions this made it easier to access data from all kind of sources and to verify this data. In the figure on the next page there is a list of all secondary data sources used to get an inventory of all the urban functions in the region. This data is always supported by fieldwork which was practiced by observations to verify the existence and whether the functions are still operational.

Urban Function	Data source
Administrative	- Government sites - Ministry of housing and local government - Google Maps
Financial Services	- Sites of financial institutions - Bank Negera Malaysia - Yelp - Google Maps - SSM Malaysia
Commerce & Trade	- Google Maps - MRA Malaysia - Yelp - SSM Malaysia - Economic Planning Unit
Hotel, Conference, Exhibition & Convention	- Hotel Booking sites (i.e. Booking.com) - Google Maps - SSM Malaysia - Local tourist office - Ministry of Tourism
Public facilities / Social Education	- Ministry of education - Local Government - Google Maps - DOSM - Ministry of Science, Technology and Innovation
Health	- Google Maps - Ministry of Health - DOSM
Recreation / Cultural / Heritage	- Ministry of Culture, Arts & Heritage - Google Maps - Local tourist office
Transportation Terminal	- Ministry of Transport - Travel Agencies - Google Maps

FIGURE 22 - DATA SOURCES USED FOR EACH INDIVIDUAL SECTOR OF URBAN FUNCTION

The data sources that are used in this research are as follows: firstly ministerial sources were accessed, because that seems to be the most reliable data, especially when the documents are published more recent. When urban

functions are not governmental sites with lists of functions proved themselves useful, especially Yelp (site that lists businesses) proves itself useful and of course Google Maps which finds results easily with certain hit words and is quite reliable especially with higher order functions. It was possible to get a comprehensive overview because for this research finding one single function of a certain hierarchy is enough to prove that the functions exists in a urban centre and not all of the urban functions have to be listed.

4.3. COMPARE HIERARCHIES

After collecting all the documents and data on the urban functions for each urban area a comparison has to be made with the urban hierarchy framework from the NUP, as said, the matrix is leading in this step. In the meantime, the table of the NUP was always open to compare with the matrix and make sure that no observations are missing. However the results are presented directly from the matrix, because due to the size and double notations the table from the NUP was not very clear and very unclear to present results with. Also because the matrix could be laid next to the inventory which made it clear where in the matrix the function fits. This analyses is done for each urban centre apart, because the functions that are in an urban area have to be compared. A limitation in this research is that the data that is found in the sources described cannot be presented, not because the present functions cannot be presented, but because it is impossible to show that there are no higher order functions, especially when functions are found on Google Maps. Therefore the sources will be explained in the next chapter with the aggregation of urban functions. Based on the data that is collected in the first step the urban functions that are present can have three options for that sector:

1) The function is “above”-level

The urban function that is found in an urban area should be in a higher order centre, in the tables represented by a green filled table cell in the higher-order centre it belongs to.

2) The function is “par”-level

Yellow blocks represent functions that are par-level, so in most cases there are a lot of yellow blocks, because there are no higher order levels. When found at the urban centre its own level this means that the function that belongs to the urban area’s hierarchy is present there.

3) The function is “below”-level

If a function of the same hierarchy-level of an urban function is not found in an urban area the sector is below-level. The next step is to see whether the function for one level lower is found, when that is the case this block will be red. If this is not the case the search continues to another level lower until the highest order function is found.

The matrix for each individual urban centre can be found in chapter 7. Subsequently these matrixes are combined in one table that gives an overview for the whole study area which can be analysed using the theory on borrowed size. In this part of the research only the presence of urban functions and the mismatch with their urban hierarchy is important. The functions that meet the first condition of borrowing size have to be further investigated on the second condition: do they locate themselves in smaller centres because the location is close to another urban centre, or are there other causes?

4.4. LOCATION FACTORS AND USERS OF URBAN FUNCTIONS

The first step to find the cause of locations is by deducting the “nature” of the functions that is incongruent with the hierarchy. When an urban area hosts a higher level function, it is still the question whether there is integration with other urban areas; one cannot tell from the matching process alone. This part of the research involves a very descriptive analysis of the functions and their catchment area, knowing what the function is and the presence of this functions across the study area make it possible to give meaning to the functions. This assessment is given on the locational context of the function within the region and observations at the function that scores a mismatch to explain whether the function might be part of an integrated system of more than one urban centre. For example, it might be the case that a function like a resort is located in a urban centre that is located next to the sea. In this case the function is not borrowed from another, but a quality of the urban centre creates good conditions for a resort. Another case might be when a minor settlement centre has a function that belongs to a major growth centre, but all other cities of this study also have these functions. This probably means that the function serves small villages that are in the same urban area and there is no integration with another

urban centre in this research and this means that the function does not have an effect on the urban structure in the scale of this research

In the case that the function's location cannot be explained by other characteristics as described above of the place. The function has a high enough influence on the regional scale, meaning that there might be users from other urban centres. In this case the question arises which urban centre the functions are borrowed from, or in other word, where do users from this urban function come from? This means that to understand the urban structure and the flows of "borrowed size" surveys have been executed at the functions that remain unexplained to see where the users of these functions come from. These surveys are very short and the only thing that this research is interested in is the residential place for these users.

The surveys were at the location of the function itself which makes the survey generalizable for the user function. Because some functions might only draw a specific groups and the users itself are not generalizable for the whole region (e.g. universities only have students) there is no need to extend these to the whole population. Because the survey is taken at the location, it is certain that the proper target group is researched: the user of that specific function. In other studies it might be important to create a survey that is generalizable, but in this research it does not matter whether the result is a sample of the whole population. The only condition to get usable results is that the survey reaches the users of the function, which is accomplished by surveying on the spot. Because on forehand it was not certain how many functions there was going to be surveyed and some surveys might be busier than others it was chosen to carry out survey of2 hours each, especially because there was a limited timeframe and a lot of travel time involved in this research.

5. HIERARCHICAL FRAMEWORK URBAN FUNCTIONS

5.1. NATIONAL URBANIZATION POLICY

This research is using borrowed size in terms of urban functions as ground to evaluate the urban system of Perak. To be able to study borrowed size it is necessary to set a baseline for the hierarchy of urban functions to the hierarchy of urban areas. This baseline is provided by the NUP which the Malaysian Federal Department of Town and Country Planning (2006) created. The appendix of this policy document contains a table in which the hierarchy of urban functions is classified for each level of urban hierarchy of Malaysian cities, which is based on population numbers. The complete table of the NUP can be found in appendix of this document. This table fits well in the framework of this research as it can be used to select indicators for each level of the urban hierarchy in terms of urban functions, the matrix that will be used in this research can be found in appendix I and is a direct derivative of the table in the NUP. The urban hierarchy is divided in 7 levels and figure 23 presents where the cities in Perak fit in this classification.

Urban Hierarchy	Population Range	Urban Centres Perak
National Growth Conurbation	> 2.5 million	
Regional Growth Conurbation	1 – 2.5 million	
Sub-regional Growth Conurbation	0.5 – 1.5 million	Ipoh
State Growth Conurbation	300.001 – 500.000	
District Growth Conurbation	100.001 – 300.000	Taiping / Kamunting Lumut, Sitiawan & Seri Manjung Teluk Intan
Major Settlement Centre	30.001 – 100.000	Batu Gajah Bidor Kampar Kuala Kangsar Seri Iskandar Sungai Siput Tapah
Minor Growth Centre	10.001 – 30.000	Gopeng Pantai Remis

FIGURE 23 - CITY HIERARCHY PERAK (NUP)

5.2. SELECTION OF URBAN FUNCTIONS

Each of the 7 levels has its distinct level of urban function that belongs to the hierarchy level for each individual sector. There are 18 different sectors indicated in the NUP (figure 24), but not all of these are investigated in this research. Within some sectors in the NUP there is just a little difference in hierarchy and are there are only three different levels divided across all 7 levels or are sectors that are equally distribute across regions. The bolt sectors in figure 24 are taking into account in this region, the analyses of these 8 sectors will provide enough evidence to evaluate the urban system of Perak, mainly because there is a strong hierarchy in these sectors. Some sectors of urban function are easier to be borrowed than others, this section will shortly discuss the choices to exclude certain functions from this research keeping the theory on borrowed size and the classification of the NUP in mind.

Sectors of urban functions			
Administration	**Financial Services**	**Commerce & Trade**	**Hotel, Conference, Exhibition and Convention**
Public Facilities / Social education	**Health**	**Recreation / Cultural / Heritage**	Religion
Police	Fire Station	Post Office	Sisa Pepejal
Electrical Supply	Telecommunication Transmitter and Broadband	Transportation Services	**Transportation Terminal**
Industry and Manufacturing	Sewerage system		

FIGURE 24 - SECTORS OF URBAN FUNCTIONS (NUP)

Religion, Police, Fire Station & Post Office

The first four sectors that are not taken into account in this research are religion, police, fire station and post office for two simple reasons. First reason is that these functions are not likely to be borrowed, the size of a police or fire station follows the size of an urban area because the more mass there is the larger the force is that is needed to serve the area. In other words, there would not be a police station located in a smaller urban centre while there is none in a larger. Secondly, and to some extent actually connected to the first reason is that the classification made in the NUP does not distinguish enough different hierarchies of the function to actually make a helpful analyses. The hierarchy is separated for every of these four sections in a national establishment, a state establishment and district or local establishments, which are to be found in that order in the region. Especially because for the study area there are only two or three different classifications in the list. Looking at the table in the appendix for example there should be a police station in every urban centre, in the district growth conurbation a district headquarters and in the state growth conurbation a state headquarters, the distinction of these functions is already hierarchical and made by the government who are also responsible behind these functions that the distribution will be hierarchical. The catchment of these functions does not allow borrowing size in these sectors. Either way one can say that these functions are simply put not functions that tend to be borrowed by other cities and therefore these functions are not looked at in this research.

Electrical supply, Sisa Pepejal, Telecommunication Transmitter and Broadband & sewerage system

These four infrastructure functions will also not be included in the research. First of all because based on the theory this infrastructure is heavily influenced by the scaling law and therefore are developed more as a urban area grows. Put in other words the larger an urban centre becomes, the more infrastructure there is. The second reason is that these functions show no distinction in functions at all for the study area. Looking at the table in the appendix for especially the electrical supply and telecommunication transmitter there is almost no variation. The electrical supply is only different for the 24 hour breakdown response centre in the lowest two hierarchies and the telecommunication only has an oceanic cable station and an earth satellite station in the highest order hierarchy. The sewerage system is the least varied, there one can find simple 'centralise system' for each urban hierarchy. The Sisa Pepejal (waste system) does have a little bit more variation, but still only distinguishes three levels of hierarchy. With such a low it is unlikely or in the case of the first two even impossible to find incongruency between size of the urban area and level of urban hierarchy considering every urban centre would have that infrastructure. For this reason those functions are not included within this research.

Transportation services

Transportation services are not included for the same reason as the functions stated above, however there are some more variations in the hierarchy of this sector. Nevertheless, the system itself is not likely to be borrowed and the transportation terminal is already included in this research and it is not necessary to investigate both. The choice to focus on the transportation terminal is because the presence of a rail would not necessarily mean that there is a railway station and the railway station is the thing people use for example. On another note there is discrepancy between transportation terminal and services which will give a strange image, this is due to classification used in the policy. An LRT line would be expected in Ipoh for example and there is no match between the expectation of a railway station and a rail. Due to these practical matters it has been chosen to include the transportation terminal alone.

Industry and Manufacturing

The table of the NUP also includes a section with industry and manufacturing where the classification includes the distinction of different industrial clusters. To figure out this for the whole study area is a research on its own which is also studies by another member (Giacomo) of the research team. In this research therefore there is no need to look globally at the clusters that are present in the study area as a way more elaborate research already does this.

5.3. Translation to matrix and arrangement of functions

Looking at the sectors that remain and are included in this research, there has to be done some cleaning to get a clearer measurement for the functions. As said, the classification sometimes has a lot of different and double notations and therefore the table on its own is very unclear to use. In addition, this research is investigating only the incongruity of urban functions for their size. This can be done most efficiently by creating indicator of functions that belong to a certain size of urban area. For example, every urban hierarchy should have a secondary school so using the table and look for a secondary school is useless, because there surely is in the higher order

urban centres. Also, a secondary school would not make a difference on the regional scale of the urban area, because the catchment area in terms of distance is not high enough (it is not a metropolitan function). Therefore lower order functions cannot be used as indicator for polycentricity. In this paragraph there will be an explanation on the distribution of urban functions according to the matrix that is used, so how is the matrix translated from the NUP, what functions belong to what urban hierarchy in what arrangement and lastly what are the most important data sources used.

ADMINISTRATIVE

The Ministry of urban wellbeing, housing and local government (n.d.) distinguishes three different level of local government: a city council *(Malay: Majlis Bandaraya)*, a municipal council *(Malay: Majlis Perbandaran)* and a district council *(Majlis Daerah)*, these levels are also found back in the table and are taken to the matrix. These functions are all middle- to low-level order functions, higher order functions are Parliament, Ministerial Headquarters, Federal Department, Embassy and Commission Office and International Organisation Offices. These functions can be considered as metropolitan administrative functions.

COMMERCE & TRADE

The commerce & trade sector might be the hardest to decipher because it has three quite different "levels" in it. This sector has some of the same characteristics as the financial services, there is a clear distinction that starts with local, national and international origin. However, there is another distinction in commerce & trade that is a derivative from the reason of shopping. There are two different kind of shopping for the regular costumer: Utilitarian (run-)shopping and hedonic (fun-)shopping (Babin, Dardin & Griffin, 1994). The former is part of the daily system (Kunc, Tonev, Szczyrba, & Frantál, 2012) buying necessities like drinks and food, principally going to the supermarket or fresh market is utilitarian shopping. Hedonic shopping, or fun-shopping is as the name already suggest shopping a leisure activity. In chapter 2 it is already discussed that 31,1% of domestic tourists travel for shopping activities. Jansen-Verbeke stated in 1998 already that there is a growing importance of shopping as a leisure / touristic activity and this trend is shown by the high number of domestic tourists in Perak as well. Run-shopping and fun-shopping is a distinction that is made by the cause a *costumer* goes to a shop and buy the products they need. However, in terms of trade this is only the last step for any product, before this the product has already been traded to eventually be sold for the general public. The matrix does not include this process per se, although wholesale is concluded as the last step of this process. Keeping in mind the difference in fun-shopping and run-shopping, there is also a difference in geographical notion between both grounds of shopping (Jansen, 1989), this is also represented in the matrix, run-shopping is found in the lower hierarchy of the matrix, while fun-shopping is found in the higher hierarchy. This can be explained by the fact that run-shopping (supermarkets) is part of the daily urban system, while fun-shopping is not and therefor the catchment area of fun-shopping (retail) is larger. Metropolitan commerce functions would be headquarters and large national hypermarkets that are used for fun-shopping.

FINANCIAL SERVICES

Within the financial services the arrangement is similar to the commerce and trade sector. The arrangement of indicators for the financial sector is based on two things, firstly the size of the service, from agent to branch to headquarters. Secondly the origin of the service, from local to national to international. Looking at the top hierarchy of financial services you would find international headquarters of a bank, insurance or other financial services. Also, the weight of a bank is one hierarchy lower than other services in this sector. Metropolitan functions found in the financial services are headquarters of national or international banks, insurance companies and other financial services. Data from all licensed financial institution of Bank Nagara Malaysia (the central bank of Malaysia) and Google Maps is used in the collection of all the branches of financial services in the urban centre.

HOTEL, CONFERENCE, EXHIBITION AND CONVENTION

This sector sums up hotel, conference, exhibition and convention, four functions that are often found together in one multifunctional building. The hierarchy is based on the number of stars of the hotel / resort and the presence of a conference / exhibition function within these hotels. An international commerce centre is considered as the highest function within this sector accompanied by a 5-star resort (metropolitan functions). In lower hierarchies' conference and exhibition can be found and the number of stars decreases. Data on the hotel, conference, exhibition and convention

EDUCATION AND PUBLIC FACILITIES

The education and facilities sector is divided into two subsectors. In the first place there are educational institutions (schools) and on the other hand other public services (i.e. libraries). The hierarchy on schools is from primary and secondary schools to universities and the hierarchy on other services is from mobile library to state library and at the highest levels national training centres and institutions. Although universities are found in the four highest urban hierarchies, both private and public are considered al metropolitan functions in this research, together with national training centres and international schools. The Perak baseline study was used for this inventory, because there was a comprehensive list of all higher education facilities in the region. To verify the data of this study Google Maps was used.

HEALTH

The health sector can be split up in hospitals and health clinics, health clinics are the functions found in lower hierarchy and in the middle hierarchy government hospitals are found just before private hospitals. The highest order functions in this section are speciality hospitals and university hospitals. The data source used for the public sector is from the latest framework of healthcare from the Ministry of Health and for the private sector are several sources used which are found in the methodology part. The most metropolitan functions for this sector are very specialised hospitals, however the table of the NUP is a little bit ambiguous about the specialism of this hospital. In the analyses that is made the presence of similar specialist hospitals in other urban centres outside the study area is considered, because a presence somewhere else would mean that there is no national weight to the function.

RECREATION

The individual pillars in this sector of this sector are quite divergent, as it includes *recreation, culture and heritage.* This sector contains cultural recreation (i.e. museum, stadium, sports) and natural recreation (i.e. national parks and green belts). In other words, the establishment of some functions in this sector is due to natural qualities of the environment, while other functions are present due to historical reasons. Other than that, there is also a link to tourism. As noted in chapter 2, Perak has the second highest number in domestic tourist of Malaysia. This divergence in functions makes it really hard to make a qualitative analysis of this sector. Metropolitan functions of the recreation sector are international or state sport complexes, big sport stadiums, national or state museums and national parks.

TRANSPORTATION TERMINAL

The transportation terminal is hierarchical classified from national transportation hubs to bus stations. High order functions that can be considered as metropolitan are in this case international airports and national hubs. An example of a Malaysian city that borrows size is Johor, which has an international airport which is above-level. In this research the analyses from two co-researchers in this research is used,

6. FUNCTIONAL PRESENCE OF URBAN FUNCTIONS

Combining the matrix and having the sources for all urban function these two can be placed on each to see whether the urban hierarchy matches the functional hierarchy in each urban area in the study area. This chapter will present a first insight of the distribution of urban functions (sub-question 1) in Perak and how the urban functions match with the urban hierarchy of cities (sub-question 2). The distribution contributes to the first part of this research and the first condition for borrowed size: *"cities host urban functions that are distinctive for cities of a higher order in hierarchy"*. This matching process therefore is used as the first indication of borrowed size on which will be built in the next chapters of this research. The chapter after this will contain descriptive analyses for the findings for each urban area in detail to evaluate whether the functions presence can be explained by other factors than the presence close to another urban areas (second condition). If this is not the case, the function will be considered as a borrowed function (Burger & Meijers, 2017) and the particular urban centre borrows size. To verify this allegation there will be a survey at these functions to measure the catchment area of these functions. This chapter only presents the data found on state-level without looking deeper into the functions itself, the 'functional presence' part of the conceptual model of this research.

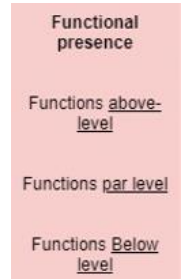

FIGURE 25 - CONCEPT OF THIS CHAPTER

Urban Function	Ipoh	Seri Manjung	Taiping - Kamunting	Teluk Intan	Batu Gajah	Kuala Kangsar	Kampar	Seri Iskandar	Tapah	Sungai Sipit	Bidor	Gopeng	Pantai Remis
Administrative	0	0	0	0	-1	0	-1	-1	-1	-1	-1	-1	-1
Financial Services	0	0	0	0	0	0	0	0	0	0	0	1	1
Commerce & Trade	1	1	1	0	0	0	0	0	0	0	0	1	1
Hotel, Conference, Exhibition & Convention	0	1	1	0	-1	0	0	0	0	0	0	0	0
Public facilities / Social Education	0	0	0	1	0	1	1	1	1	0	0	0	0
Health	0	0	0	1	0	0	0	-1	0	0	-1	0	0
Recreation / Cultural / Heritage	0	1	1	0	0	0	1	-1	0	-1	-1	0	0
Transportation Terminal	0	1 / -1	0	-1	1	1	1	0	0	1	0	0	0

FIGURE 26 – FUNCTIONAL PRESENCE OF URBAN FUNCTION HIERARCHY IN THE STUDY AREA

Figure 26 presents the score for each individual sector within each urban area in the study area. The green cells (1) represent an above-level functional presence for the corresponding urban area, the yellow cells (0) represent a par-level functional presence and the red cells (-1) automatically represent a below-level functional presence. At first sight, one might conclude that there is a substantial number of mismatching scores and that would not be a wrong conclusion. However, Burger & Meijers (2017) consider the relationship as two sides from the same medal and this also means that a borrowed size effect for one place implies that one or more other places are in an agglomeration shadow.

One can analyse the table of figure 26 considering above definition of borrowed size. Although there are above- and below-level scored present all over Perak, this does not necessarily mean that they explain each other – so that a place is in an agglomeration shadow because another place borrows size from it. For the first four sectors (administrative, financial services. commerce & trade and hotel, conference, exhibition & convention) there are no findings of both above- and below-level functions. This observation suggests the absence of borrowed size in these sector from other places, despite the presence of above-level functions. Van Oort et al. (2015) found that more isolated cities also host higher-order functions than their own hierarchical level due to the absence of competition. The functional presence of the first four sections might indicate that the cities function more isolated as there are no agglomeration shadows, however a more detailed analyses is needed to fully understand these findings. It could also be the case that there is a lot of regional integration and the whole state performs as one entity and borrowing size as singular entity from places beyond the Perak border.

The other four sectors in this research do have both above- and below- level scores, which at first sight might indicate borrowed size. For public facilities / social education this would mean a function in Pantai Remis (minor settlement centre) that is borrowed by Kuala Kangsar, Tapah, Seri Iskandar and Kampar (all major settlement centres). Looking at the location and connectivity of Pantai Remis towards the other urban areas one might find out that all urban areas are outside the 1-hour isochrone from Pantai Remis. Van Oort et al. draw the line for isolated cities at the 45-minute isochrone and therefore is there no relationship expected between those urban centres. However, the findings of the educational system will be elaborated in detail in the next chapter also because the findings of above-level functions in the four urban areas is noteworthy. Healthcare does not seem to be very subservient for borrowed size necessarily, however the location of specialized hospitals might lead to flows, especially when located in smaller urban areas. The table implies a possible integration between respectively Teluk Intan (above-level) and Seri Iskandar / Bidor (below-level) in the health care-sector at least. In addition, the recreational and transportation services sectors both also show both above- and below-level scores, which might also indicate the presence of borrowed size and agglomeration shadows and several integrated cities in the study area. Recreation, cultural and heritage is a very broad sector in terms of functions with a different angle of emergence, therefore it is hard to conclude anything based on these findings on this scale. It is not clear whether the amenities that are relinquishing are in the same sub-sector as the amenities that are borrowed, therefore the next chapter will be important in this sector. Transportation terminals on the other hand seems not to be a very likely sector to borrow size or functions, when cities are very well integrated and agglomeration (network) externalities are put in motion then the law of scaling (Pumain, 2004) proofs to have a particularly strong influence on the emergence of infrastructure. Besides that, the transportation terminals are closely linked to the presence of the associated mode of transport and the infrastructure of the modality, meaning that the design of the structure has more influence than the size of the urban centre per se. For example, a train station will be located along the railway network, if an urban centre is not connected to the network there will be no station. If in this situation a smaller urban area has a train station and a larger urban area does not it will not mean that the smaller urban centre borrows size from the larger urban centre, because the situation can be explained by the presence of a rail network.

This chapter was needed to present the distribution of functions in Perak compared to the hierarchical size of the cities and used to answer the first two questions as a base to build on in the rest of this research. The sub-questions that are answered are: (*1) How is the distribution of urban functions in Perak?* and *(2)What sectors have a mismatch between the size and presence of urban functions in Perak?.* This chapter presented the inventory of functions in cities according to the hierarchical level and how the distribution of functions is in Perak. These findings do not yet tell a comprehensive story which can be used to answer the main question of this research and it is hard to say anything about the urban structure of Perak so far. The next chapter will go deeper into the story of the findings, presenting the situation for each individual urban area of the study area and will help to answer for each finding whether the urban borrows size and where possible size is borrowed from.

7. URBAN CENTRES AND THEIR FUNCTIONS

This chapter can be seen as the base of the analyses, here will be explained what urban areas in the study area borrow size and where there is integration between urban areas. In this chapter the results for each urban area will be analysed in more detail to evaluate whether the incongruity that is found between the hierarchy of urban functions and the size of an urban city also meets the locational requirement. The answer on sub-question 4 is trying to be found for each city: What explains a possible mismatch between the size and function of an urban centre? For each urban area the specific findings that are incongruent will be presented and their respective weight on the integration between cities. This will be done by a combination of an analyses of the specific functions and if needed more in-depth research (e.g. surveys – sub-question 4). This chapter works towards the conclusion with an overview of urban centres that borrow size in the study area and where they borrow size from, and this tells whether there is integration between urban areas or not (sub-question 5).

7.1. IPOH

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities/ Social Education							
Health							
Recreation/ Cultural/ Heritage							
Transportation Terminal							

FIGURE 27 - MATCHING MATRIX IPOH

The first urban centre that will be discussed is the largest in the study area: Ipoh, a sub-regional growth conurbation. The functional presence of Ipoh already gives important insight for the end conclusion of this research. The polycentric scenario described in chapter 3 identified the presence of functions higher than the largest urban area (in this case Ipoh) as an indication for a polycentric region. Looking at the results for Ipoh in figure 27 there is almost no incongruency found in functions of Ipoh. The city council of Ipoh is joined by several state governmental establishments, which is all according to the expectation in the state capital of Perak. No higher order national functions are found in Ipoh or elsewhere in the study area, and therefore this will not be repeated for each city. There are no headquarters in the financial sector found in Ipoh nor the rest of the study area, according to Banka Negera Malaysia all headquarters are found in Kuala Lumpur. The only sector that has higher order functions is the commerce & trade sector which is the results of the presence of international brands in AEON shopping malls (e.g. H&M). There are three of these malls in Ipoh, of which two of these malls a survey took place:

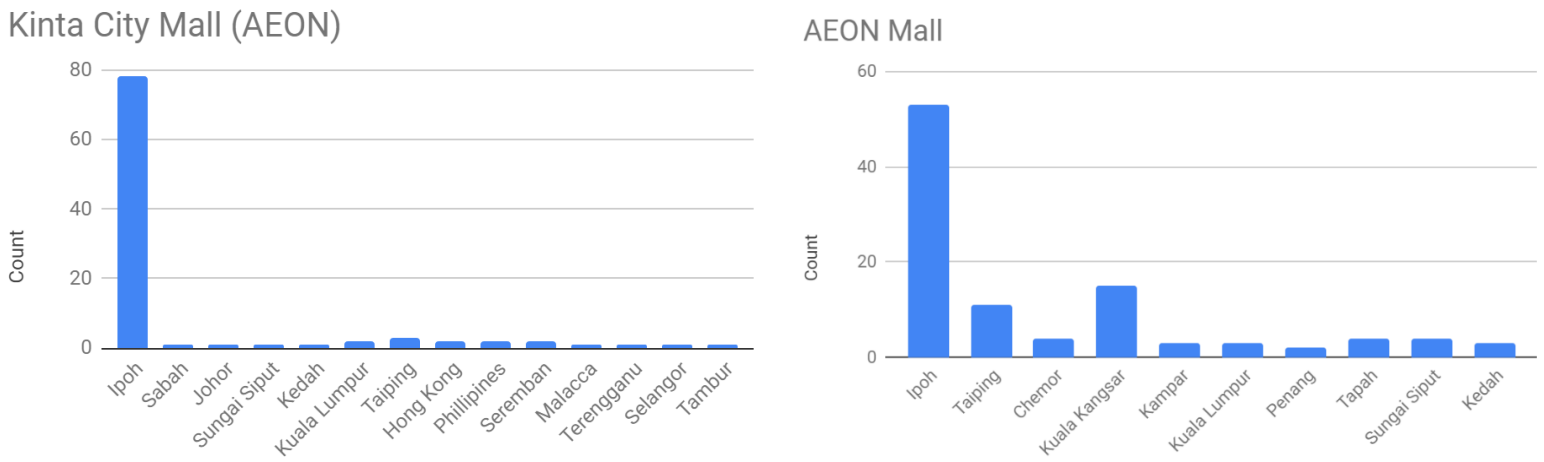

FIGURE 28 - RESULTS OF SURVEYS AT THE KINTA CITY MALL (LEFT) AND THE KLEDAING AEON MALL (RIGHT)

The first (left) survey was executed at the Kinta City Mall (see figure 29) during a weekday, while the second one took place at a more northern Kledang AEON Mall during the weekend. The first observation that can be made is that most of the users of these malls are from Ipoh itself (131 out of 200 questioned; 65%) and that there are no real other outliers. In the weekend the results are a little bit less skew, meaning that there are more people in the weekend that visit the malls in Ipoh for a day of shopping. This number can be explained by domestic tourism that is already discussed in the second chapter of this research. Another observation is that most people that visit Ipoh for a day of shopping from outside are from urban areas that are located next to the north-south expressway (e.g. Kuala Kangsar, Taiping, Kampar, Tapah) which implies that there is a relation between the presence of this highway and the presence of higher-level shopping facilities in Ipoh. This highway might have created connectivity that leads to people visiting Ipoh for shopping. One might say from these observations that there is to some extend borrowing size in Ipoh driven by a good connection and domestic shopping tourism which results in international brands locating themselves in Ipoh. At the same time the malls in Ipoh cannon compete against the large shopping centres in Kuala Lumpur or Georgetown, which also means that the the critical mass for national functions is not reached. Also the surveys tell that the catchment area excludes some of the other urban centres in the study area.

FIGURE 29 - KINTA CITY MALL (IMAGE FROM HTTPS://WWW.NST.COM.MY/BUSINESS/2018/08/406178/KIP-REIT-BUYS-AEON-MALL-KINTA-CITY-RM208M)

The recreational sector firstly supposed to score at the national level with the presence of the Kledang Saiong Forest Park in Ipoh, but during fieldwork and conversations with locals it turned out that the user-base for this so-called national park are only from Ipoh. In this case it turned out that the functions nomenclature was incongruent with

the actual function for the region. This means that the park itself is of national significance, where the nature has to preserved, but the recreational baths are only serving the population of Ipoh.

In Ipoh there are several private (specialist) hospitals, in number by far more than any other city in the study area. Figure 30 shows where these private hospitals are located. The specialist hospitals that are found in other urban centres in the study area always belong to a hospital chain and are relatively small (e.g. KPJ Specialist hospital has 48 beds in Taiping and 23 in Manjung comparing to 275 in Ipoh). These hospital chains however are not seen as borrowed size as there are establishments of these chains all over medium- and big-sized urban areas in peninsular Malaysia. The hospitals that are specialist in very specific treatments (e.g. eye specialist, maternity clinic) are unique to Ipoh in the study area, but are also found in larger cities (Kuala Lumper, Johor etc.), which means that there is no reason to consider these as borrowed size on their own. However, because the number of hospitals in Ipoh is this large in comparison to other urban centres in the study area it is important to mention this. The city-rank size distribution of the study area might be this skew that there is no ground for specialist hospitals in other parts of the study area, this might explain the number of hospitals that is located in Ipoh comparing to other parts of the study area. Altogether, for specialist health care people have to travel longer times, the fact that the most specialised hospitals in the study area are located in the largest urban centre indicate that there is no integration, because otherwise these hospitals will be found elsewhere. One exception is the Anson Bay medical centre in Teluk Intan, which will be discussed in the section about Teluk Intan.

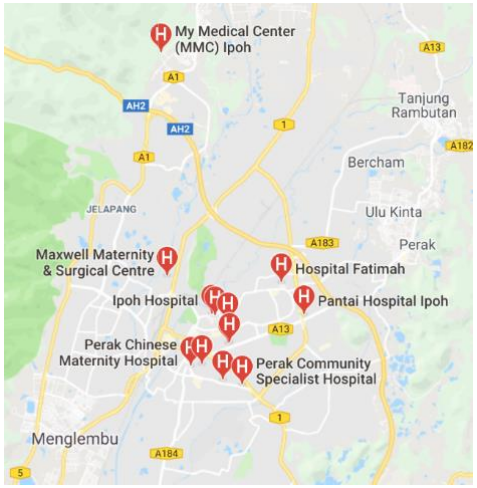

FIGURE 30 - PRIVATE HOSPITALS IN IPOH (IMAGE FROM GOOGLE MAPS)

The other three sectors that are not yet discussed all score a par-level score and the highest functions will be discussed shortly for a better understanding of the functions in Ipoh. There are 5-star hotels in Ipoh, but no international commerce centres, for that one has to go to another, larger city. Next to the Ipoh train station there is a large bus terminal which together offer possibilities to travel outside of the state, however this cannot be considered as a national transportation hub. Moreover, in terms of transportation terminal there is also an airport which provides flights to Johor Bahru and Singapore. Despite Singapore is an international destination, several governmental documents (among other Perak 2040) do not consider this airport as an international airport, but as a domestic airport. Lastly, there is a state library found in Ipoh next to several schools and universities and the same story as with the hospital's accounts. In terms of numbers the highest number of higher-order functions are found in Ipoh, but this can be explained by the mass of the urban area itself and the need to provide enough places for students in Ipoh. Within the educational sector there are however interesting findings in the urban centres in close proximity in Ipoh, which will be discussed later on.

7.2. LUMUT, SITIAWAN AND SERI MANJUNG

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities/ Social Education							
Health							
Recreation/ Cultural / Heritage							
Transportation Services							
Transportation Terminal							

FIGURE 31 - MATCHING MATRIX LUMUT, SITIAWAN AND SERI MANJUNG

The functions in Lumut, Sitiawan and Seri Manjung (Manjung in short) score in many aspects remarkable for a district growth conurbation. First of all, one can notice that there is a lot of incongruency found in this region and mainly above-level functions and second of all because most of this incongruency can be explained by the geographical location of Manjung at sea. First of all, the hotel, conference, exhibition & convention sector scores at the largest national level because there are hotels which score up to 5-stars and there is even some resort in the Lumut port area. One can say that these resorts do not locate themselves in this area because the proximity of Lumut close to other urban centres in the study area, the reason of those hotels to settle is because of the natural resources: the beach and Pangkor island (incl. ferry). Therefore it is excluded that this function is a result of size borrowing from the study area, but a function that settles in the area because its attraction towards tourists. There are more special functions in this area because of the natural location, for example the Royal Malaysian Marine Base (which is not a function included in this research) and as well the seaport. This seaport is seen as an above-level function, but again is obviously not located in Lumut because there is mass borrowed from other urban centres, but because of the seaside location. Meanwhile there is also a function relinquishing in the transportation terminal sector namely a train station and this incongruency can be explained by the fact that Manjung is not connected to the railway network. This is a relevant finding for other research, as it indicated that the rail network of the study area has a deficiency at this moment. The bus station of Manjung offers possibilities to Kuala Lumpur, Ipoh and Georgetown which means that it is not necessarily a national transportation hub, more a secondary hub.

FIGURE 32 - AEON MALL IN SITIAWAN (IMAGE FROM HTTP://WIKIMAPIA.ORG/26242535/AEON-MALL-SERI-MANJUNG)

There are four sectors that score par-level, meaning that Manjung is home of respectively a district office, private hospital, a vocational school and national branch in the financial sector. These sectors do not show any incongruency and therefore do not need more investigation. The commerce & trade scores an above-

level score in Manjung and again due to the presence of a hypermarket from AEON (shown on the picture). However, while in Ipoh there are three of those hypermarkets there is only one in Manjung and this store is significantly smaller. Therefore, despite the nomenclature of the mall as hypermarket and considering the fact that in Ipoh the users were already for a significant part from Ipoh itself, the function cannot be considered the same level. At the same time, the closest larger urban centre of the study area is Seri Iskandar and it takes somewhat more than 45 minutes to travel between those cities. For people in Seri Iskandar it is just as far to travel to Ipoh as to Manjung. It is already discussed that van Oort et al. (2015) consider cities beyond the 45-minute isochrone as isolated centres and this is probably what drives Manjung to host these functions. Close to Manjung there are some townships (Ayer Tawar & Changkat Keruing) that also belong to the Manjung district and also Pantai Remis is located within this district. All these towns combined create a mass that is enough to host some higher order functions in Manjung, because the place is disconnected to the rest of the study area. Van Oort et al. (2015) argue that this effect occurs when a city is isolated and therefore there is no competition which leads to higher order functions in smaller cities due to isolation.

The last sector to be discussed is recreation, recreation scores par-level in Manjung although this might be an observation worth the discussion. The reason for discussion is because of recent changes in the use of the stadium which might influence the weight of this stadium. The state stadium of Perak is located in Ipoh, however recently PKNP FC changed its venue from the Perak stadium in Ipoh to the stadium in Manjung. So-far this does not change anything to the fact that the stadium of Ipoh is considered as the state stadium as one team does not change this, however if more activities or teams might move to the Manjung stadium, the weight of this stadium and the users it draws will change. Figure 33 shows respectively the Manjung stadium (left) and the Perak stadium (right) and it can be said that the Perak stadium is considerably larger than the Manjung stadium, this is verified by the number of seats: 30.000 in the Perak stadium versus 12.000 in the Manjung stadium.

FIGURE 33 – THE MANJUNG STATDIUM (LEFT) AND THE PERAK STADIUM (RIGHT) (IMAGES FROM: HTTPS://SEMUANYABOLA.COM/STADIUM-MANJUNG-BAKAL-MENJADI-GELANGGANG-RASMI-PKNP-FC/ AND HTTPS://US.SOCCERWAY.COM/TEAMS/MALAYSIA/PERAK/3259/VENUE/)

This concludes the analyses of Manjung, where despite many incongruence there is no borrowed size largely because of the city's distant location and frugal connectivity to other urban areas of the study area. This connectivity and location are very important drivers for borrowing size as is the city rank-size distribution. Later, in the conclusion of this research there will also be a part on these conditions for borrowed size and their presence in the study area as the influence of this conditions might be of significant value for the results that are presented now.

7.3. TAIPING – KAMUNTING

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 34 - MATCHING MATRIX TAIPING-KAMUNTING

Majlis Perbandaran Taiping or municipal Taiping is the district capital of Larut & Matang and hosts no other administrative functions, therefore scoring par-level to begin with. Other sectors that score par-level are financial services (again no headquarters or international branches), the public facilities / social education, there are no universities in Taiping, but there is a vocational school. In the health sector there are again no real specialist hospitals, only the KPJ hospital, which is already discussed in the section about Ipoh, which is simply too small to be considered as borrowed size. The transportation terminal sector would have scores above-level in earlier days, but since the airport of Taiping is not operational anymore the highest function in this sector is the train station, which is not considered as above-level.

In March of 2019, the year this research was written, the star publicised that the district growth conurbation of Taiping has been recognised among the top 3 most green cities in the world (The Star Online, 2019) and this is shown in the amount of green recreation there is available in Taiping. Next to the Taiping zoo and Bukit Larut (Maxwell Hill), which both are not considered as urban function in this research, Taiping is home to the first botanical / lake garden of Malaysia. This 64-hectare garden is exemplary for the green situation of the urban area and can be considered as a state park to some extent and therefore Taiping – Kamunting scores above-level in the recreational sector of this research. Figure 35 gives an impression of the lake gardens, in of the top green spots in Taiping. Because of Taiping was Perak's state capital between 1867 and 1937 the Perak Museum is still present in Taiping, however observations during weekdays and weekends have proved that there is only a small amount of visitors and therefore this museum cannot be considered to have an effect on the urban system of the study area.

FIGURE 35 - LAKE GARDENS IN TAIPING (IMAGE FROM THE STAR ONLINE)

Another sector that scores above-level in this urban area is again the commerce and trade and again this is due to the presence of an AEON Mall. The fact that again this urban area is home to an AEON Mall proves that this hypermarket branch is not necessarily a good example of a high-order function and in urban areas with more than 200.000 residents it is more than normal to host a shopping facility. Again, there is no need for a survey in this location because the weight of this so-called hypermarket seems to be overrated, already in Ipoh the most users where from the urban area itself and there is no difference expected here.

Closely linked to the presence of the recreational high-order functions and to some extent the commerce functions (large domestic tourism) is the score of the hotel sector in Taiping – Kamunting which is also incongruent with the size of the urban area. To check whether the explanation of this incongruency can be derived from the presence of the recreational sector there is a survey held in front of the entrance of the Taiping Zoo which is located in the lake gardens. This survey is held with the assumption that a high number of visitors from outside the urban area lead to more overnights and that leads to a better locational advantage for hotels. The results of this survey are presented in figure 36 and shows a verification of the expectations, most people that were asked are not from Taiping. The is a strong link towards Ipoh and Penang, which can be explained by the good connection of Taiping in-between those cities on the North-South expressway. Therefore, the presence of higher order hotels cannot be considered as borrowed size, as this is a result of the recreational amenities there are in Taiping and not the result of the close proximity of other urban areas.

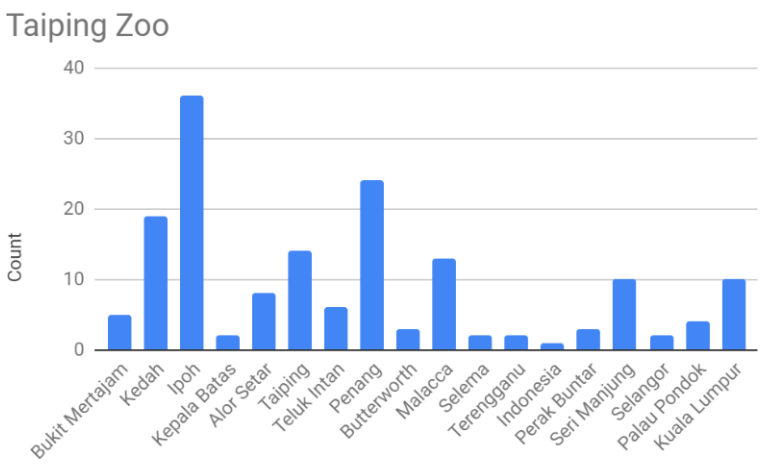

FIGURE 36 - RESULTS OF TAIPING ZOO SURVEY

In short there is no trace of borrowed size in Taiping as there is again no evidence for the presence of higher-order functions that is explained by a connection with another urban centre. Again, there are other locational factors that have stronger influence on the emergence of above-level functions. In this case the fact that Taiping is located close to a hill which resulted in a lot of rain (Taiping is the wettest urban area in Malaysia) has led to the perfect conditions for green developments and recreation.

7.4. TELUK INTAN

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities/ Social Education							
Health							
Recreation/ Cultural / Heritage							
Transportation Terminal							

FIGURE 37 - MATCHING MATRIX TELUK INTAN

Next urban centre to be analysed is Teluk Intan and since the urban centres are becoming less populous there are less higher-order functions to be found. Again, Teluk Intan is a district growth conurbation and the administrative capitals of the Hilir Perak district. From now on the incongruent scores will be discussed without further ado, because from now on the results are more straightforward and there is nothing special to address about the other sector, only in special cases a par-level function will be picked out because there are findings that are of a certain interest. This happens to be the case for the social education sector in Teluk Intan , with the presence of the campus for medical and medicine faculty in Teluk Intan, which is in size not comparable to other universities that will be discussed in later urban areas and is considered as a satellite location for the MARA university who operate in Perak from Seri Iskandar. Therefore, it is discussable to add these campuses to the above-level score it is now, because it are only branches of a university. However, the presence of a university is considered to be something for state growth conurbations or larger and therefore these campuses are included as an above-level score. Later on, it will be discussed why the presence of large university campuses is not due to borrowed size, but to other factors like cheaper ground prices and more space to build. But because the campus of Teluk Intan is rather small in comparison to universities in other medium-sized urban areas there is no need to deepen into it now.

FIGURE 6 - ANSON BAY MEDICAL CENTRE (IMAGE FROM: HTTPS://WWW.FLICKR.COM/PHOTOS/ZAIMHQ/15724872093)

Another function that scores above-level is the healthcare. Despite the campuses mentioned above are both located near the governmental hospitals there is no clear link between them and therefore it cannot be said that that hospital is considered a university hospital. Nevertheless, there is another hospital in Teluk Intan which needs further investigation, the Anson Bay

Medical Centre, specialist in orthopaedic surgery, shown in figure 38. The finding of this hospitals may be explained by borrowed size, the only question that remains is whether this is because of the integration with other urban centres of the study area.

The results of the survey at Anson Bay Medical centre are shown in figure 39. In a conversation a spokesperson at Anson Bay already stated that the most important reason for the founder of this specialist hospital in Teluk Intan to open was the long travel distance for people in the Hilir Perak district to go to a specialist hospital and most patients are from Teluk Intan and the Hilir Perak district and some of them come from further. The survey at the hospital verified this statement, by far most people are from Teluk Intan, followed by Langkap and Selekoh, townships close to Teluk Intan in the Hilir Perak District. There were however also some people found from other urban areas in this research, respectivily Ipoh (1), Bidor (3) and Sitiawan (1) altough in only small number. The small number implies that there is not a strong link between those cities and in some cases it can be possible that the surveyed person was a relative of a patient. From this findings therefore it can be concluded that the Anson Bay is predominalty focussed on patients in the Hilir Perak and the integration with other urban centres in the study area is minimal.

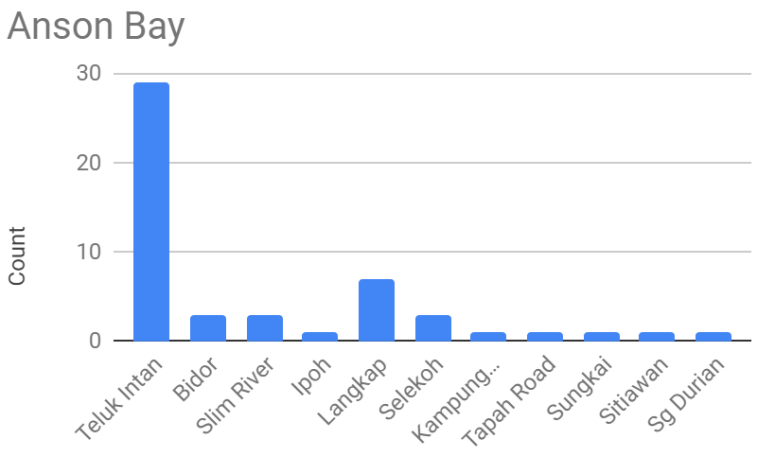

FIGURE 39 - RESULTS OF SURVEY AT ANSON BAY MEDICAL CENTRE

Lastly there is a relinquisment of transportation terminals in Teluk Intan, which is a result of the adsence of a train station in Teluk Intan. To travel by train people in Teluk Intan should go to Bidor, which is 40-minutes by car. However there is a bus terminal which compensates the lack of a train station, as the bus in Malaysia is equally important as the train network.

7.5. BATU GAJAH

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 40 - MATCHING MATRIX BATU GAJAH

The Majlis Daerah Batu Gajah, or district office of Batu Gajah is the first major settlement centre where inconsistency between the nomenclature of the National Urbanization Policy and that the Ministry of urban wellbeing, housing and local government are in dissonance with each other. This results in a below-level score of Batu Gajah which does can just be explained by the fact that there is a different name given for the district office than would be expected according to the matrix. Batu Gajah is not the only urban centre with this observation, but to be consistent with the matrix these are all notices with a below-level score. Nevertheless, these findings will never be considered as borrowed size, because the locations of a district council and the nomenclature of these councils is always an administrative choice and not the result of locational causes.

The location close to Ipoh however has a notable effect on the score of the hotels in Batu Gajah. Despite the presence of touristic attraction Kellie's castle within Batu Gajah's borders (see Figure 41) there is a relinquishment of hotel functions found in Batu Gajah. Meaning that the highest star hotel in Batu Gajah is only 2-stars, while a major settlement centre is supposed to host 3-star hotels. Because hotels are used by tourists there was no need to survey this location, because no helpful results should have resulted. Considering that Batu Gajah is in close proximity to Ipoh, and one can say that there is a larger touristic value comparing to Batu Gajah in Ipoh purely based on the number of facilities and attractions. And lastly the fact that Kellie's Castle is included in travel trips from Ipoh, it can be said that tourists are more likely to stay in Ipoh than Batu Gajah and visit Batu Gajah as a day trip. Therefore, it can be said that there is a link between Ipoh and Batu Gajah, which is directed in the direction of Ipoh, which strengthens a monocentric tendency between those cities. Meanwhile it has to be said that the absence of hotel functions is not the result of mass of users in Ipoh from Batu Gajah, because there will not be many users in Batu Gajah who use the hotels in Ipoh, it is only a touristic preference to stay in Ipoh.

FIGURE 41 - KELLIE'S CASTLE IN BATU GAJAH (IMAGE FROM: HTTPS://THECULTURETRIP.COM/ASIA/MALAYSIA/ARTICLES/KELLIES-CASTLE-A-HAUNTED-SCOTTISH-MANSION-IN-THE-MALAYSIAN-JUNGLE/)

Lastly there is again incongruency of a transportation terminal, which is due to district transport terminal in district capitals. In more major and minor settlement centres in the rest of this analyses this will be the case due to the presence of a train stations and larger bus terminals in those settlements. It cannot be said that the presence of other urban areas provides the mass to host a train station, instead the explanation of this presence is due to the direction of the rail network and therefore this will not count as borrowed size. In general, there is a small link between Batu Gajah and Ipoh in terms of hotels, but at the same time Batu Gajah provides most functions on itself and there is no agglomeration shadow found on the base of the daily urban system for the residents of Batu Gajah itself. Therefore, the integration with Ipoh seems rather small and the residents from Batu Gajah do not need Ipoh as provider for some amenities.

7.6. KUALA KANGSAR

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 42 - MATCHING MATRIX KUALA KANGSAR

The major settlement centre Kuala Kangsar is the administrative district capital of the district that goes by the same name. Kuala Kangsar again scores above-level in the transportation terminal, and again because of a district transport terminal so this will not be further discussed. Kuala Kangsar is the first settlement of this study area that scores above-level in public facilities / social education because of the presence of a large university. The university located in Kuala Kangsar is a private university with the name of Universiti Sultan Azlah Shah (USAS), the campus of the USAS was completed in 2008 and the university gain full university status only in 2016. The university states officially that the location is strategically located because of the attraction of the Royal town of Kuala Kangsar to local and international tourists, however, there seems more to it. Looking at the survey that is executed at the university (figure 43) one can clearly see that students at the USAS come from all corners of Malaysia, but most of the students are from Perak (e.g. Ipoh, Tapah and Kuala Kangsar). There is a clear link with Ipoh, which makes sense as students chose to stay relatively close to their hometown. In the analyses

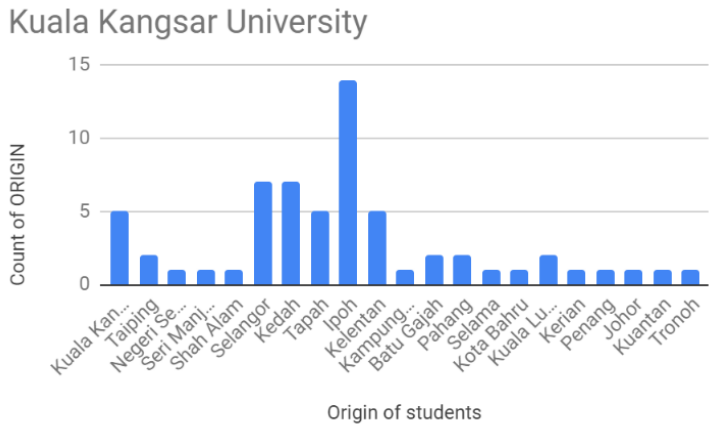

FIGURE 43 - RESULTS OF SURVEY AT USAS - KUALA KANSAR

of the next urban areas there will be more universities that are located in major settlement centres and it will be discussed whether this observation can be explained by an integration with other urban centres, mainly with Ipoh which is the most proximate larger urban centre.

Looking at figure 44 there is an overview of land transaction costs in the study area between 2014-2018 (source thesis Daan Florijn). This timeframe is not necessarily the same as the emergence of the different universities in the study area that are going to be discussed, but because there is little data on the time period when the campuses of the universities were built. In the graph shown in figure 44 it can be seen that the transaction prices in the larger urban centres is significantly higher than the transaction costs in the smaller urban centres. Assuming that the difference between these prices in urban areas is at least similar to the period when those universities were build it can also be a good reason for a private investor to build a campus that need a lot of ground in urban centres relatively close to Ipoh, but at a far lower price. Another reason might be the availability of land, because according to sources in the region where my fellow students had contact with it turned out that ground in Ipoh for example is more scarce than in other, smaller urban centres and there are more restriction in Ipoh due to the protection of heritage.

So, there might be other reasons for the location choice that are not directly pointing towards an integration of the system of the urban system of the study area. Furthermore, the nature of a university is not contributing to the integration of the urban system. When people choose their university, especially in Malaysia, they also start to live for the years of study on the campus. This means that there is not a flow of students between the urban centres, because the students live close to the university. Therefore, it is discussable if a university in Malaysia even has an effect on the integration of the urban system comparing to other countries.

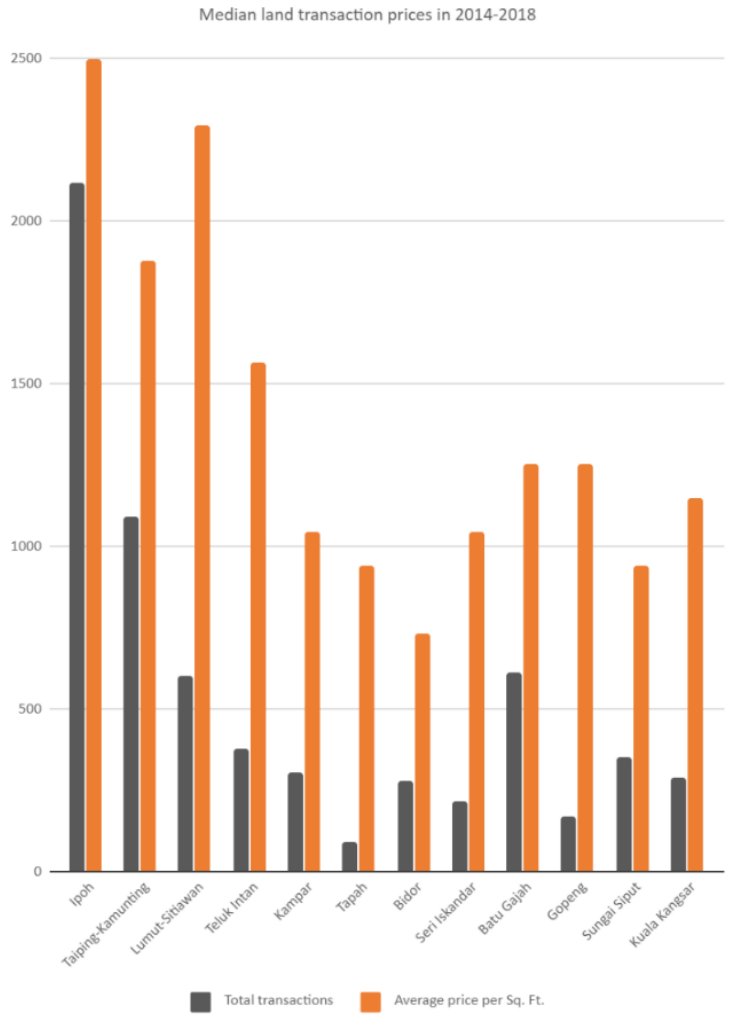

FIGURE 44 - LAND TRANSACTION COSTS IN THE STUDY AREA (2014-2018) (THISIS DAAN FLORIJN, 2019)

7.7. KAMPAR

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 45 - MATCHING MATRIX KAMPAR

In Kampar the situation is similar with that of Kuala Kangsar and to some extent to Batu Gajah, again this district capital scores below-level in the administrative sector and again there is a train station which scores above-level. Another similarity is that Kampar is home to a large private university, which is above-level for this major settlement centre. The Universiti Tunku Abdul Rahman (UTAR) welcomed their first students in 2001 and has grown since then. A difference is that the 1300-acre piece of land on which the campus is built was donated by the Perak State government (source: official website of UTAR) which means that there was a big incentive for the investor to locate the campus in Kampar. This means the location or connection towards other urban centres was of no importance in this decision. Looking at the results of the survey in figure 46 one can again say that Ipoh is the main supplier of students at the UTAR, but still there are students from throughout peninsular Malaysia which means that the location close to Ipoh is not of significant importance and there is no clear relation between the location of Kampar against the location of other urban centres.

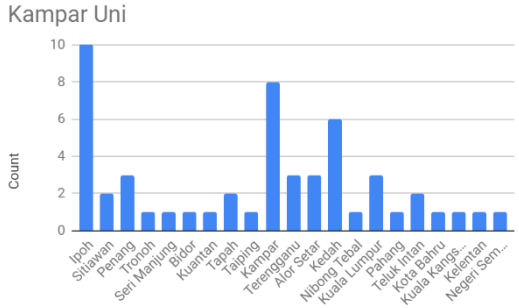

FIGURE 46 - RESULTS OF SURVEY AT UTAR - KAMPAR

FIGURE 47 - SPORT CENTER KAMPAR SENTRAL (IMAGE FROM: HTTPS://WWW.FACEBOOK.COM/CSHBADMINTONACADEMY/)

Kampar is also home to Kampar Sentral (figure 47), a district sport complex, which is above-level in the recreational sector. The name however already implies that the sport complex serves people in the Kampar district and considering that there are no other urban areas of the study area in this district this implies that there is no connection. To verify this thought the owner of Kampar Sentral was asked and his answer was according to the expectation. He told that most of the people that are enrolled at the sport complex are from the UTAR and generally every person that is enrolled is from Kampar. An

explanation for the emergence of this sport complex is that Kampar with almost 80.000 residents is the largest of the major settlement centres and therefore has enough mass to host this function.

7.8. TAPAH

Tapah	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 48 - MATCHING MATRIX TAPAH

District capital of the Batang Padang district Tapah shows the same characteristics as previous major settlement centres and therefore the analyses of this urban centre can be short. As shown in the matrix of this urban centre it shows that again there is a discrepancy between the nomenclature in the administrative sector. A more noteworthy finding is that there is again a university located in this urban centre, making this the third urban centre with a university as above-level score. Unlike the previous two this campus is not private but a public university from MARA. This campus is again considered as a satellite location operated by the state office in Seri Iskandar, which will be discussed later, but this campus is in size and number of faculties much larger than the one in Teluk Intan. The university is located approximately 4 km from the centre of Tapah in the direction of Tapah road and therefore the connection with Tapah seems even less in this case as the campus is completely separated from Tapah and offers all facilities the students need. The survey shows again a tremendous number of students from Ipoh and still the observation that there are students from all over Malaysia, which is similar to the other study areas. About Tapah can be said that as a major settlement centre it performs as expected with the exception of the university. This university is a public university which means that again there is a governmental choice of the Perak government behind the location and this university has no influence on the integration of the (daily) urban system.

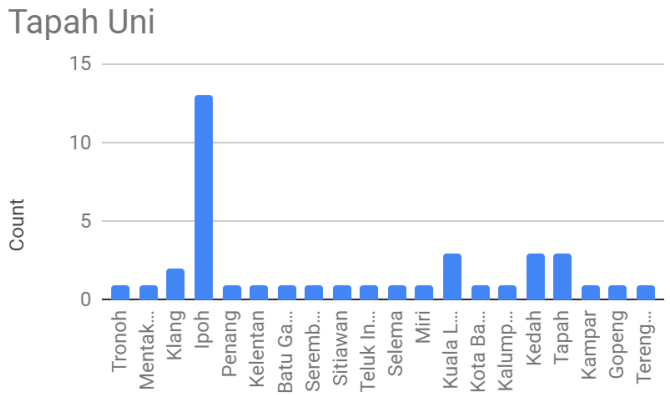

FIGURE 49 - RESULTS OF SURVEY AT MARA TAPAH

7.9. BIDOR

Urban Function	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities/ Social Education							
Health							
Recreation/ Cultural/ Heritage							
Transportation Services							
Transportation Terminal							

FIGURE 50 - MATCHING MATRIX BIDOR

Under the administrative jurisdiction of Tapah and thus also in the Batang Padang district one can find Bidor, which is also a major settlement centre. Because Bidor is the second urban centre in the same district several public urban functions are relinquishing in this urban centre. First of all, there is obviously no district office which is due to the fact that this office is found in Tapah. Second of all there is again no train station, which will be not discussed further because this finding is clear now. Because many recreational facilities are offered by the district office these are also found in Tapah instead of Bidor. So due to governmental reasons this function is lacking in the urban centre of Bidor and for recreational facilities residents from Bidor are dependent on the facilities Tapah has to offer. Despite this fact there is no borrowed size found in Tapah where this was expected so it is the question whether this is the case or people recreate on their own term in Bidor.

FIGURE 51 - POLIKLINIK DR. AZHAR IN BIDOR (IMAGE FROM HTTPS://WWW.FACEBOOK.COM/POLIKLINIKDRAZHARDANRAKANRAKANRAWANG/)

The last function that is lacking is a hospital in Bidor and to understand how this is possible, because people who are in trouble should have good access to hospitals there was a short conversation at a health clinic in Bidor. It turned out that since the government has not yet decided to build a hospital they are dependent on the hospital in Tapah: *"We send our patient to the hospital in Tapah and sometimes to specialist hospitals in Ipoh or Teluk Intan" (spokesperson Poliklinik Dr. Azhar Dan Rakan-Rakan)* This means that people have to wait at least 16 minutes when there is an emergency. Although this finding is not necessarily important for borrowed size it tells something about the status of the health system in the study area at the moment. Where there are hospitals found in most of the urban areas, some areas are still quite remote and hard to reach. In this case it is not that bad, but other urban centres like Pantai Remis might experience more trouble as there are longer waiting times. Nevertheless, in short one can say that the administrative hierarchy of Bidor in comparison to Tapah leads to the relinquishment of some functions and residents in Bidor are to some extent dependant on Tapah.

7.10. SERI ISKANDAR

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 52 - MATCHING MATRIX SERI ISKANDAR

Seri Iskandar is the district capital of the Perak Tangah district and is home to several educational facilities as already mentioned when introducing the study area. The two most noteworthy facilities are the Universiti Teknologi Petronas (UTP) and the Universiti Teknologi MARA (UiTM), respectively a private and a public university. UiTM was formerly located in Manjung, but since 1999 UiTM is operating from Seri Iskandar, the strategic location between Ipoh and Manjung is given as explanation for this location. One can say that the combination between the strategic location and the cheaper land prices can be a good argument for the location choice of Seri Iskandar, because it is a central location in the state of Perak. Because access was denied during the field research there is no data on the users for this university, but the same outcome as the other universities is expected.

The UTP established in Seri Iskandar in 1997 and currently is one of the top universities in Malaysia ranked in the top 100 universities of Asia in 2019 by QS (source: UTP site). Therefore, the university can be seen as the leading university in the study area. The campus of the UTP is approximately 160 acres in size, which means that the land cost and space availability could have played a significant role in the location choice of this private university. The outcome of the survey is again comparable to the other universities, verifying that Ipoh is the main supplier of the universities in the study area, but that there is a large catchment area.

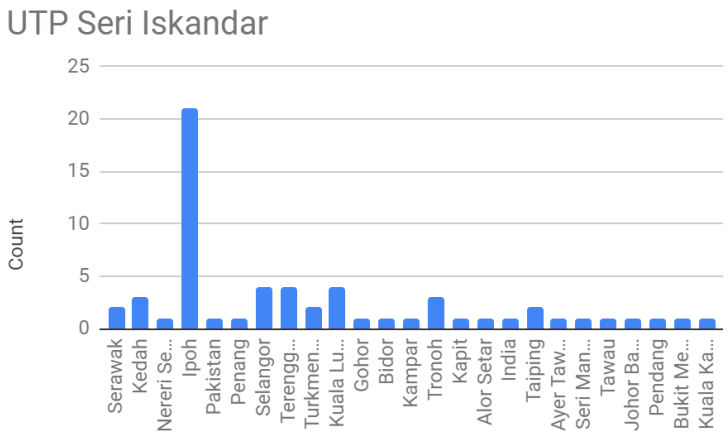

FIGURE 53 - RESULTS OF SURVEY AT UTP SERI ISKANDAR

The current absence of recreational & sporting facilities in Seri Iskandar is due to the fact that these are absent outside of the campuses. Therefore, the residents who are not students in Seri Iskandar cannot use these facilities, which is why these functions are considered as below-level. However, this also means that a significant part of the residents in Seri Iskandar (all students) and therefore the mass of people that is considered as not able to use is smaller, decreasing the mass of people with approximately 12.000 (exact numbers are unknown). Leading to a situation in which Seri Iskandar is still a major settlement centre but getting close to be a minor settlement centre which is was in the year 2000. Since Seri Iskandar is a developing urban centre, for exact numbers can be referred to Daan Florijn's research within this joint research who investigated more on that.

For recreation facilities there was no source that could make clear where people go, but the health sector in Seri Iskandar scores below-level as well. On the question where patients are referred to the answer from the Seri Iskandar Health Clinic on Facebook was:" Ok.... *Since my clinic is near to 2 district Hospital which located 20km from my clinic... emergency patient we refer to Hospital Changkat Melintang and Hospital Batu Gajah...".* This is quite far for emergency patients, but as already stated, Seri Iskandar is going through a developing phase at the moment and a hospital in Seri Iskandar is one of the upcoming projects (NST, 2018). This means that the situation is Seri Iskandar is getting more and more par-level in the upcoming year, leading to a similar looking situation as Kuala Kangsar and Kampar, but with even more educational facilities.

7.11. SUNGAI SIPUT

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 54 - MATCHING MATRIX SUNGAI SIPUT

The last major settlement centre is Sungai Siput, the situation in Sungai Siput is similar to a lot of previous findings, there is no district office since Sungai Siput is in the Kuala Kangsar district, which also explains the relinquishment of recreation functions. The district sport facilities are found in Kuala Kangsar, comparable to the situation of Bidor and Tapah. Sungai Siput is however again connected to the rail network and provides district transportation possibilities which explained the above-level score on terminals. Other than that Sungai Siput scores par-level, meaning that there are no findings are which would imply that Sungai Siput is integrated a lot with other nearby cities.

7.12. PANTAI REMIS

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 55 - MATCHING MATRIX PANTAI REMIS

The first of two minor settlement centres is Pantai Remis, which is located in the north of the Manjung district and therefore has its administrative council located in Seri Manjung. The sectors that score above-level in Pantai Remis are financial services and commerce & trade because the presence of branches of national companies and stores like for example Billion, which is the largest store located in Pantai Remis. This Billion store is shown in figure 56 and one can say that this store is not comparable to the AEON malls found in Ipoh, Taiping or Manjung. Considering that Manjung is the closest urban area to Pantai Remis with a travelling time of somewhat above 30 minutes and Manjung already hosts hierarchical higher functions in the commerce and trade sector there is no need to investigate this mall further. These functions in both sectors are not considered as metropolitan functions, meaning that the mass needed to host these functions to speak of an integrated region with this observation. Van Oort et al. (2015) also proved that urban centres that are isolated are more likely to host higher order functions, which might be the driving force behind the above-level findings in Pantai Remis. The relative isolation of Pantai Remis might lead to substantial high travel times to stores in other cities that a store like Billion establishes itself in Pantai Remis because there is no competition with a larger urban centre. This explanation would in the end results to Pantai Remis as a single island in the urban system.

FIGURE 56 - BILLION MARKET IN PANTAI REMIS (IMAGE FROM: HTTPS://MALAYSIAREALITYBITES.BLOGSPOT.COM/2017/08/BILLION-PANTAI-REMIS-PERAK.HTML)

7.13. GOPENG

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative							
Financial Services							
Commerce & Trade							
Hotel, Conference, Exhibition & Convention							
Public facilities / Social Education							
Health							
Recreation / Cultural / Heritage							
Transportation Terminal							

FIGURE 57 - MATCHING MATRIX GOPENG

The second minor settlement centre and last urban centre to be analysed is Gopeng, located in the Kampar district only 20 minutes in the south of Ipoh. The rule of isolation like the case of Pantai Remis does not apply for Gopeng, one can say that if there was a certain degree of isolation, Gopeng would definitely be one of the urban centres where this would have effect. Despite the relatively good connection (located near the north-south expressway) and close proximity other urban centres Gopeng has exactly the same matrix as Pantai Remis. Figure 58 presents the banks of Ipoh, Kampar and Gopeng as illustration to see that the financial sector in Gopeng (right picture) might be above-level with the score of a bank without meaning that this score can be considered as borrowed size. The fact that Gopeng generally hosts all the functions one could expect for a minor settlement centre proves that there is no integration with Ipoh. Residents of Gopeng will have to go to Ipoh for higher level functions, but that is according to the central place theory, where there is different order of hierarchies.

FIGURE 58 - BANKS IN IPOH, KAMPAR AND GOPENG (IMAGES FROM GOOGLE STREETVIEW)

8. Conclusion & Discussion: Centricity of Perak measured by borrowed size

The main question of this research was: "*What can be said about the urban system of Perak on how urban functions in the "Perak Diamond" are distributed, is there a incongruence between the size of a urban centre and its functions, what are the explanations for a possible incongruence and the possible presence of borrowed size or agglomeration shadows in the "Perak Diamond"?".* The biggest part of this research question has been answered throughout the research, but the most important question remains: What does the urban structure of Perak looks like and does the "Perak Diamond" exist? Looking back to all the urban centres that are discussed in the previous chapter and the number of times there are metropolitan functions found in smaller urban areas which borrow size from other region it can be said that the study area is no interconnected urban region. Ipoh as the largest urban area does not host functions that belong to the national hierarchy, in fact there are no functions of these hierarchies found throughout the whole study area. Would the region be interconnected, and the region be polycentric as sketched in scenario 1 there would be functions present of national hierarchy. Since these functions are not found it can be said that there is no polycentric system in the study area.

Then the question remains which of the other two scenario's fits best to the situation of the study area: is there a monocentric system of an archipelago system? Most urban centres host functions that are par-level, meaning that the connectivity is good enough to support a system that looks like the hierarchical system of the central place theory. This means that in general the system can be described as a monocentric hierarchical system. Ipoh is the largest centre and hosts the highest order functions followed by Manjung and Taiping. This hierarchical distribution can be explained by the fact that Ipoh has a dominance in terms of population mass also represented in the rank-size distribution in chapter 2. In regions where borrowed size is dominant and urban centres are interconnected the rank-size distribution is most often quite linear (e.g. Randstad the Netherlands) In the study area the gap is so big that the highest order functions are always allocated in the largest urban centre, because that's where by far the largest group of users is. In a more distributed area, where connectivity is also better, the mass of population is approximately the same in every urban centre and the allocation is not necessarily following a hierarchy anymore. There is no reason to assume the system of the study area is an archipelago, which would be the case if connectivity is so bad that there would be no possibility for people to use functions in Ipoh and those functions will be hosted by another place. The Anson Bay Medical centre however is a function that is distinctive for such a system and Pantai Remis and Gopeng also shown some low-order functions that would imply an archipelago system. The Anson Bay Medical Centre however serves mostly other urban centres in the Hilir Perak district and the urban functions found in Gopeng and Pantai Remis of such low-order that it does not necessarily is above-level.

The educational system is an odd one in this study, although there are four urban centres with an above-level score these universities do not denote an integrated or interconnected region. Whether the reason of location is land pricing or space availability, students of universities in Malaysia are staying at the campus from the beginning of their study to the end of their study. This means that the location of the universities does never have an impact on the network between urban centres and that for students it does not matter where the campus is located. If students had to travel from time to time to the university like in the case of the Netherlands this would be a totally different case, because then the location could be located at a place where enough mass is reached to draw students which is not the case in the Malaysian educational system.

There are also some limitations in this research, the table that is used and especially in the lower-order creates a very strong distinction between hierarchies. The banks and stores found in Pantai Remis and Gopeng could just as well have belonged to a lower hierarchy. Also, the division of urban centre hierarchies is very strict, if an urban centre would have one resident over 100.000 it would belong to another level and therefore host higher-order functions. This was not the case in this study area, but could be the case in future research. Another point that should be considered in future research is that some functions are borrowed more easily than others. Functions like hospitals or administrative functions are not necessarily easily borrowed, because people need access to hospitals and the location of administrative functions is most of the time decided by governments. This research sometimes had this issue, for example with the train station which proves that transportation terminal functions are not likely a good indicator for borrowed size. For this research is was helpful to look at as many functions as possible, because there was also a qualitative description for each function. To look what kind of urban functions are more easily to be borrowed might be an interesting topic for future research. Such research would make it

possible to measure borrowed size by looking only at the functional presence without considering a descriptive analyses, because it is proved that those functions have a tendency to be borrowed.

All in all, the functions present have given a helpful image of what is present in what urban centre and what kind of network there is present in the “Perak Diamond”. Considering the urban presence of functions, the lack of metropolitan functions in the study area and the little links that there are found between urban centres. One can conclude that the metropolitan functions are found in The location of metropolitan urban functions in this area turn out to indicate a more monocentric urban system. This means that there is no sign of the so-called “Perak Diamond”.

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APPENDIX I – URBAN HIERARCHY NUP

TABLE 4.0 HIERARCHY AND URBAN AMENITIES

Urban Hierarchy	National Growth Conurbation	Regional Growth Conurbation	Sub-Regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Urban	Refer To List of Towns from Appendix 1	Georgetown	Ipoh	Kota Bharu	Temerloh - Mentakab	Refer To List of Towns from Appendix 1	Refer To List of Towns from Appendix 1
		Johor Bahru	Malacca	Kuala Terengganu	Lumut - Sitiawan		
		Kuantan		Alor Setar	Muar - Batu Pahat - Kluang		
				Kangar			
Population Range	2.5 Million and Above	1.5-2.5 Million	0.5-1.5 Million	300,001 - 500,000	100,001 - 300,000	30,001 - 100,000	10,001 - 30,000
	(Projected Population 8.5 Million by 2020)	(Except for Kuantan 0.64 Million)		(Except for Kangar 0.09 Million)			
Function	Parliament						
	Ministerial Headquarters						
	Federal Department						
Administration:	Embassy and Commission Office	Embassy and Commission Office		Consulate Office			
	International Organisation Offices	International Organisation Offices					
	International Organisation Secretariat	International Organisation Secretariat					
	City Council, Town Council and District Council	City Council, Town Council and District Council	City Council, Town Council and District Council	Town Council, District Office	Town Council, District Office	District Office	District Office
	State Government and District Office	State Government and District Office	State Government and District Office	State Government and District Office	State Government and District Office	State Government and District Office	State Government and District Office
Economy	Bank	Bank	Bank	Bank	Bank	Bank	Bank
Financial Services:	National Bank (Headquarters)	National Bank (Headquarters, Regional)					
	International Bank (Headquarters, Regional and Branch)	International Bank (Branch)	International Bank (Branch)	International Bank (Branch)			
	Local Bank (Headquarters and Branch)	Local Bank (Headquarters and Branch)	Local Bank (Branch)	Local Bank (Branch)	Local Bank (Branch)	Local Bank (Branch)	Local Bank (Branch)
	Insurance	Insurance	Insurance	Insurance	Insurance	Insurance	Insurance
	International Insurance Company / Broker (Headquarters, Regional and Branch)	International Insurance Company / Broker (Headquarters, Regional and Branch)	International Insurance Company / Broker (Branch)	International Insurance Company / Broker (Branch)	International Insurance Company / Broker (Agent)		
	Local Insurance Company / Broker (Headquarters and Branch)	Local Insurance Company / Broker (Branch)	Local Insurance Company / Broker (Branch)	Local Insurance Company / Broker (Branch)	Local Insurance Company / Broker (Branch and Agent)	Local Insurance Company / Broker (Branch and Agent)	Local Insurance Company / Broker (Agent)
	International and Local Insurance Company Agents and Representatives	International and Local Insurance Company Agents and Representatives	International and Local Insurance Company Agents and Representatives	International and Local Insurance Company Agents and Representatives			
	Stock & Commodity / Security	Stock & Commodity / Security	Stock & Commodity / Security	Stock & Commodity / Security	Stock & Commodity / Security	Stock & Commodity / Security	Stock & Commodity / Security
	Malaysian Security Commission						
	Bursa Malaysia						
	International Stock / Security Company (Headquarters, Regional and Branch)	International Stock / Security Company (Branch)					
	Local Stock / Security Company (Headquarters and Branch)	Local Stock / Security Company (Headquarters and Branch)	Local Stock / Security Company (Headquarters and Branch)	Local Stock / Security Company (Branch / Kiosk)	Local Stock / Security Company (Branch / Kiosk)	Local Stock / Security Company (Kiosk)	Local Stock / Security Company (Kiosk)
	Other Financial Services	Other Financial Services	Other Financial Services	Other Financial Services	Other Financial Services	Other Financial Services	Other Financial Services
	International Financial Services (Headquarters, Regional & Branch)	International Financial Services (Headquarters, Regional & Branch)	International Financial Services (Branch)				
	Local Financial Services (Headquarters, Regional and Branch)	Local Financial Services (Headquarters, Regional and Branch)	Local Financial Services (Branch)	Local Financial Services (Branch)	Local Financial Services (Branch)	Local Financial Services (Representatives / Agents)	Local Financial Services (Representatives / Agents)

Urban Hierarchy	National Growth Conurbation	Regional Growth Conurbation	Sub-Regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Commerce & Trade	Business and Service	Business and Service	Business and Service	Business and Service	Business and Service	Business and Service	Business and Service
	International Headquarters and Regional Headquarters	International Headquarters and Regional Headquarters	International Headquarters and Regional Headquarters				
	Local Office (Headquarters and Branch)	Local Office (Headquarters and Branch)	Local Office (Headquarters and Branch)	Local Office (Headquarters and Branch)	Local Office (Branch and Representative Office)	Local Office (Branch and Representative Office)	Local Office (Representative Office)
	Professional Service and Business Agent	Professional Service and Business Agent	Professional Service and Business Agent	Professional Service and Business Agent	Professional Service and Business Agent	Professional Service and Business Agent	Professional Service and Business Agent
	International Headquarters and Regional Headquarters	International Headquarters and Regional Headquarters	International Headquarters and Regional Headquarters	Local Office (Headquarters and Branch)	Local Office (Headquarters and Branch)	Local Office (Headquarters and Branch)	Local Office (Headquarters and Branch)
		Miscellaneous	Miscellaneous	Miscellaneous	Selected Services	Selected Services	Selected Services
	Wholesale Commerce	Wholesale Commerce	Wholesale Commerce	Wholesale Commerce	Wholesale Commerce	Wholesale Commerce	Wholesale Commerce
	International Headquarters (Regional and Branch)	International Headquarters (Regional and Branch)	International Headquarters (Branch)				
	Local Headquarters and Branch	Local Headquarters and Branch	Local Headquarters and Branch	Branch and Representative Office	Branch and Representative Office	Representative Office	
	Retail Commerce at Store (Excluding Specialisation and Specialisation)	Retail Commerce at Store (Excluding Specialisation and Specialisation)	Retail Commerce at Store (Excluding Specialisation and Specialisation)	Retail Commerce at Store (Excluding Specialisation and Specialisation)	Retail Commerce at Store (Excluding Specialisation and Specialisation)	Retail Commerce at Store (Excluding Specialisation and Specialisation)	Retail Commerce at Store (Excluding Specialisation and Specialisation)
	International General Store and International Hypermarket (Branch and Regional Headquarters)	International General Store and International Hypermarket (Branch)	International General Store (Branch)	International General Store (Branch)	International General Store (Branch)		
	Local General Store (Regional Headquarters and Branch)	Local General Store (Regional Headquarters and Branch)	Local General Store (Branch)	Local General Store (Branch)	Local Miscellaneous Store (Branch)	Local General Store (Branch)	
	International Hypermarket (Branch)	International Hypermarket (Branch)	International Supermarket (Branch)	International Supermarket (Branch)	International Supermarket (Branch)		
	Local Hypermarket (Regional Headquarters and Branch)	Local Hypermarket (Regional Headquarters and Branch)	Local Supermarket (Branch)	Local Supermarket (Branch)	Local Supermarket (Branch)	Local Supermarket (Branch)	Local Supermarket (Branch)
	International Convenience Store (Regional Headquarters and Branch)	International Convenience Store (Regional Headquarters and Branch)	International Convenience Store (Branch)	International Convenience Store (Branch)	International Convenience Store (Branch)	International Convenience Store (Branch)	
	International and Local Retail Shop (Miscellaneous Goods Including Food, Clothing, Car, etc)	International and Local Retail Shop (Miscellaneous Goods Including Food, Clothing, Car, etc)	International and Local Retail Shop (Miscellaneous Goods Including Food, Clothing, Car, etc)	Local Retail Shop (Miscellaneous Goods Including Food, Clothing, Car, etc)	Local Retail Shop (Miscellaneous Goods Including Food, Clothing, Car, etc)	Local Retail Shop (Miscellaneous Goods Including Food, Clothing, Car, etc)	Local Retail Shop (Miscellaneous Goods Including Food, Clothing, Car, etc)
	Used Goods Retail at Store	Used Goods Retail at Store	Used Goods Retail at Store	Used Goods Retail at Store	Used Goods Retail at Store	Used Goods Retail at Store	Used Goods Retail at Store
	International and Local Used Goods (Miscellaneous Goods)	International and Local Used Goods (Miscellaneous Goods)	Local Used Goods (Miscellaneous Goods)	Local Used Goods (Miscellaneous Goods)	Local Used Goods (Selected Goods)	Local Used Goods (Selected Goods)	Local Used Goods (Selected Goods)
	Other Retail Commerce (Not at Store)	Other Retail Commerce (Not at Store)	Other Retail Commerce (Not at Store)	Other Retail Commerce (Not at Store)	Other Retail Commerce (Not at Store)	Other Retail Commerce (Not at Store)	Other Retail Commerce (Not at Store)
	Informal Local Retail	Informal Local Retail	Informal Local Retail	Informal Local Retail	Informal Local Retail	Informal Local Retail	Informal Local Retail
	Local Services Repairing Personal and Household Goods	Local Services Repairing Personal and Household Goods	Local Services Repairing Personal and Household Goods	Local Services Repairing Personal and Household Goods	Local Services Repairing Personal and Household Goods	Local Services Repairing Personal and Household Goods	Local Services Repairing Personal and Household Goods
	Direct Selling (International and Local)	Direct Selling (International and Local)	Direct Selling (International and Local)	Direct Selling (International and Local)	Direct Selling (International and Local)	Direct Selling (International and Local)	Direct Selling (International and Local)
	Retail of Inflammable Goods for Vehicle (Retail Station, LNG/NGV) - Local	Retail of Inflammable Goods for Vehicle (Retail Station, LNG/NGV) - Local	Retail of Inflammable Goods for Vehicle (Retail Station, LNG/NGV) - Local	Retail of Inflammable Goods for Vehicle (Retail Station, LNG/NGV) - Local	Retail of Inflammable Goods for Vehicle (Retail Station, LNG/NGV) - Local	Retail of Inflammable Goods for Vehicle (Retail Station, LNG/NGV) - Local	Retail of Inflammable Goods for Vehicle (Retail Station, LNG/NGV) - Local

Urban Hierarchy	National Growth Conurbation	Regional Growth Conurbation	Sub-Regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Hotel, Conference, Exhibition And Convention (MCE)	Hotel and Conference Facilities	Hotel and Conference Facilities	Hotel and Conference Facilities	Hotel and Conference Facilities	Hotel and Conference Facilities	Hotel and Conference Facilities	Hotel and Conference Facilities
	Resort / Exhibition (> 5 Star)						
	Budget Hotel Till 5 Star	Budget Hotel Till 5 Star	Budget Hotel Till 5 Star	Budget Hotel Till 5 Star	Budget Hotel Till 4 Star	Budget Hotel Till 4 Star	Budget Hotel Till 2 Star
	Conference Exhibition and International Commerce Centre	Conference Exhibition and International Commerce Centre	Conference Exhibition and Centre	Conference Exhibition and Centre	Exhibition		
		Rest House	Rest House	Rest House	Rest House	Rest House	Rest House
Industry / Manufacturing	International & Multimedia ICT Cluster	International & Multimedia ICT Cluster	National Multimedia ICT Cluster	National Multimedia ICT Cluster			
	International & National Telecommunication Cluster	International & National Telecommunication Cluster	National Telecommunication Cluster				
	International and National Knowledge Based Industry	International and National Knowledge Based Industry	National Knowledge Based Industry				
	Manufacturing Cluster Based on National Resources (International and National)	Manufacturing Cluster Based on National Resources (International and National)	Manufacturing Cluster Based on National Resources (National)	Cluster Based on National and Local Resources	Cluster Based on Local Resources	Cluster Based on Local Resources	Cluster Based on Local Resources
	International and National EKS Food Cluster	International and National EKS Food Cluster	Local EKS Food Cluster	Local EKS Food Cluster	Local EKS Food Cluster	Local EKS Food Cluster	Local EKS Food Cluster
	International and National General Assembly and Manufacture	National General Assembly and Manufacture	Local General Assembly and Manufacture	Local General Assembly and Manufacture	Local General Assembly and Manufacture	Local General Assembly and Manufacture	Local General Assembly and Manufacture
Public Facilities / Social Education	University / Public College	University / Public College	University / Public College	University / Public College			
	University and Private College	University and Private College	University and Private College	University and Private College			
	International Cooperative Training Institution	International Cooperative Training Institution					
	Research and Development	Research and Development					
	National Training Centre	National Training Centre					
	National / State Library	National / State Library	State Library	State Library	Public Library	Mobile Library	Mobile Library
	International School	International School	International School				
	Technical / Vocational School	Technical / Vocational School	Technical / Vocational School	Technical / Vocational School	Technical / Vocational School		
					Primary and Secondary School	Primary and Secondary School	Primary and Secondary School
Health	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	
	Private Hospital	Private Hospital	Private Hospital	Private Hospital	Private Hospital		
	University Hospital	University Hospital	University Hospital	University Hospital			
	Specialist Centre	Specialist Centre	Specialist Centre	Specialist Centre			
	Health Clinic	Health Clinic	Health Clinic	Health Clinic	Health Clinic	Health Clinic	Health Clinic
	Private Clinic	Private Clinic	Private Clinic	Private Clinic	Private Clinic	Private Clinic	Private Clinic
Recreation / Cultural / Heritage	International / State District Sport Complex	International / State District Sport Complex	State / District Sport Complex	State / District Sports Complex	District Sports Complex	Multi Purpose Hall	Multi Purpose Hall
	National / State Stadium	State Stadium	State Stadium	State Stadium	Stadium	Stadium / Playground	Playground
	National / State Museum	State Museum	State Museum	State Museum			
	Theatre / Auditorium	Theatre / Auditorium					
	National Park						
	Regional/ State Park	Regional/ State Park	State Park	State Park			
	Town Park	Town Park	Town Park	Town Park	Town Park	Town Park	Local Park
		Recreation Area Network: Green Belt (Central Forest Spine)	→	River Reserve and Forest →	Active and Passive Recreational Area		
Religion	National Mosque						
	State / District Mosque	State / District Mosque	State / District Mosque	State / District Mosque	District Mosque	District Mosque	Mosque
	Islamic Centre	Islamic Centre	Islamic Centre	Islamic Centre			
	Other Non-Islamic Religion Centre	Other Non-Islamic Religion Centre	Other Non-Islamic Religion Centre	Other Non-Islamic Religion Centre	Other Non-Islamic Religion Centre	Other Non-Islamic Religion Centre	Other Non-Islamic Religion Centre

Urban Hierarchy	National Growth Conurbation	Regional Growth Conurbation	Sub-Regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Police	Royal Malaysian Police Headquarters						
	Police Contingent Headquarters	Police Contingent Headquarters	Police Contingent Headquarters	Police Contingent Headquarters			
	Police District Headquarters	Police District Headquarters	Police District Headquarters	Police District Headquarters	Police District Headquarters	Police District Headquarters	
	Police Station	Police Station	Police Station	Police Station	Police Station	Police Station	Police Station
Fire Station	Malaysian Fire and Rescue Headquarters						
	State Fire and Rescue Headquarters	State Fire and Rescue Headquarters	State Fire and Rescue Headquarters	State Fire and Rescue Headquarters			
	Fire Station	Fire Station	Fire Station	Fire Station	Fire Station	Fire Station	Fire Station
Postal Services	Main Post Office	Main Post Office					
	Post Office	Post Office	Post Office	Post Office	Post Office	Post Office	Post Office
Infrastructure Facilities and Utility Sewerage Services	Centralise System	Centralise System	Centralise System	Centralise System	Centralise System (Priority to Identified Towns)	Centralise System (Priority to Identified Towns)	Centralise System (Priority to Identified Towns)
Sisa Pepejal	Land-fill Sanitary Disposal	Land-fill Sanitary Disposal	Land-fill Sanitary Disposal	Land-fill Sanitary Disposal	Land-fill Sanitary Disposal	Land-fill Sanitary Disposal	Land-fill Sanitary Disposal
	Incinerator	Incinerator	Incinerator	Incinerator			
	Scheduled Solid Waste Disposal	Scheduled Solid Waste Disposal					
Electrical Supply	Main Intake Station (PMU)	Main Intake Station (PMU)	Main Intake Station (PMU)	Main Intake Station (PMU)	Main Intake Station (PMU)	Main Intake Station (PMU)	Main Intake Station (PMU)
	National Load Dispatch Centre On National Grid	Regional Load Dispatch Centre For Transmission System	Regional Load Dispatch Centre For Transmission System	State Load Dispatch Centre For Transmission System	District Transmission Office	District Transmission Office	Transmission Local Office
	Remote Load Distribution Centre	Remote Load Distribution Centre	Remote Load Distribution Centre	Remote Load Distribution Centre	Remote Load Distribution Centre	24 Hour Breakdown Response Centre	24 Hour Breakdown Response Centre
Telecommunication Transmitter and Broadband	Fibre Optic Network	Fibre Optic Network	Fibre Optic Network	Fibre Optic Network	Fibre Optic Network	Fibre Optic Network	Fibre Optic Network
	Wireless Broadband Network	Wireless Broadband Network	Wireless Broadband Network	Wireless Broadband Network	Wireless Broadband Network	Wireless Broadband Network	Wireless Broadband Network
	Transmitter & Receiver Station	Transmitter & Receiver Station	Transmitter & Receiver Station	Transmitter & Receiver Station	Transmitter & Receiver Station	Transmitter & Receiver Station	Transmitter & Receiver Station
	Oceanic Cable Station						
	Earth Satellite Station						
	TV And Digital Radio Transmitter Station	TV And Digital Radio Transmitter Station	TV And Digital Radio Transmitter Station	TV And Digital Radio Transmitter Station	TV And Digital Radio Transmitter Station	TV And Digital Radio Transmitter Station	TV And Digital Radio Transmitter Station
	Internet Central Node Network	Internet Central Node Network	Internet Central Node Network	Internet Central Node Network	Internet Central Node Network	Internet Central Node Network	Internet Central Node Network
Transportation Services	High Speed Rail	High Speed Rail	High Speed Rail	High Speed Rail			
	Commuter / Rail	Commuter / Rail	Commuter / Rail	Commuter / Rail	Commuter / Rail		
	LRT	LRT	LRT				
	Monorail / Tram	Monorail					
	Bus	Bus	Bus	Bus	Bus	Bus	Bus
	Taxi	Taxi	Taxi	Taxi	Taxi	Taxi	Taxi
Transportation Terminal	National Integrated Transportation Hub						
	International And Domestic Airport	International And Domestic Airport	Domestic Airport	Domestic Airport			
	International And National Seaport	International And National Seaport					
	State Public Transportation Terminal	State Public Transportation Terminal	State Public Transportation Terminal	State Public Transportation Terminal	District Public Transportation Terminal		
	Bus / Taxi Station	Bus / Taxi Station	Bus / Taxi Station	Bus / Taxi Station	Bus / Taxi Station	Bus / Taxi Station	Bus / Taxi Station
	Railway Station	Railway Station	Railway Station	Railway Station	Railway Station	Railway Station	Railway Station

APPENDIX II – TRANSLATED URBAN HIERARCHY MATRIX

	National Growth Conurbation	Regional Growth Conurbation	Sub-regional Growth Conurbation	State Growth Conurbation	District Growth Conurbation	Major Settlement Centre	Minor Settlement Centre
Administrative	Parliament - Ministerial Headquarters	Embassy Office - International Cooperation Office	City Council	Consulate Office	Municipal Council	Municipal Council	District Council
Financial Services	International Headquarters	National Headquarters	International Financial Branch	International Bank Branch	National Financial Branch	Local Financial Branch / National Bank Branch	Local Financial Agents
Commerce & Trade	Commerce & Trade Headquarters / International hypermarket	National Hypermarket	International Wholesale / Business & Service / Retail	National Wholesale / Business & Service / Retail	National General Store / Supermarket	Local General Store	Local Supermarket / Retail
Hotel, Conference, Exhibition & Convention	Resort / Exhibition (>5 stars)	Budget Hotel till 5 stars - International Commerce Centre	Budget Hotel till 5 stars	Budget Hotel till 5 stars - Conference Centre	Budget Hotel till 4 stars - Exhibition	Budget Hotel till 3 stars	Budget Hotel till 2 stars
Public facilities / Social Education	National Library	National Training Centre	State Library	Public / Private University	Technical / Vocational School	Primary / Secondary School - Public Library	Primary / Secondary School - Mobile Library
Health	National Specialist Centre	Specialist Centre - University Hospital	Specialist Centre - University Hospital	Specialist Centre - University Hospital	Private Hospital	Government Hospital	Health / Private Clinic
Recreation / Cultural / Heritage	National Park	International Sport Complex - Theatre / Auditorium	Green Belt (Central forest spine) - Regional Park	State museum / Stadium / Park / Sport Complex	District Sport Complex - District Museum - District Park	Stadium - Town Park	Playground - Local Park
Transportation Terminal	National Integrated Transportation Hub	Domestic & International Airport - (Inter)national Seaport	Domestic Airport - State Public Transportation Terminal	Domestic Airport - State Public Transportation Terminal	District Public Transportation Terminal	Bus / Taxi Station - Railway Station	Bus / Taxi Station - Railway Station