Scientific Research Paper

Stickiness unraveled

Company survival on Dutch science and technology parks

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Contents

1 Introduction

Successful science and technology parks (hereafter: STPs) should positively impact networking, innovation and economic performance of companies and regions [i]. These knowledge-intensive areas vary in knowledge anchor, ownership, size, focus and location type [ii]. As these locations are often publicly funded there is an urgency that STPs are properly developed and managed [iii]. This paper aims to explore the impact of STP characteristics on the duration of stay of resident companies on Dutch STPs, while considering heterogeneity among these companies. Previous research has shown that the type of knowledge anchor on STPs has an impact on the duration of stay of companies. Duration of stay is relatively longer on university-based STPs compared to corporate STPs (i.e., a large corporate company functions as main anchor) [iv]. Consequently, the research question is: which STP characteristics impact the duration of stay of resident companies on Dutch STPs, while considering heterogeneity among these companies? Insights on 'stickiness' or survivability aids STP managers and policymakers to shape the future landscape of STP and areas of innovations.

2 Literature review

2.1. Added value of STP location characteristics for companies

On STPs proximity to organisations such as universities, research institutes and other companies create opportunities for knowledge sharing and collaboration [v]. Moreover, the urban setting and the presence of a university or other knowledge institutes are sources of human talent. The proximity to clients and suppliers improves innovative output, therefore outperforming competitors [vi]. In essence, STPs are area developments that provide for critical infrastructure, facilities and services (e.g., R&D facilities and services) [vii]. Through economies of scale, STPs supply shared facilities and services, which can lead to cost saving for companies. This is the case with incubators, a common facility on STPs, which accommodate users with shared (R&D) spaces [viii].

2.2. Survivability of companies

As STPs are home to a variety of companies, it follows that the value that companies seek is related to their business development phase. As benefits vary among types of companies, survivability and therefore duration of stay likely change among companies. Especially for younger companies that aim to bridge the gap between research and innovations survival can be challenging (i.e., the valley of death) [ix]. On average, cost saving benefits are more sought after by younger companies, while image and prestige benefits are more desired by mature companies [x]. STP size will likely positively impact survivability as sizeable STPs can provide for the economies of scale that are able to fund critical infrastructure, facilities and services. Moreover, a larger pool of companies provides companies opportunities to network, collaborate and do business. Finally, the knowledge anchor, i.e., STP type, is likely to impact company survivability. On one hand universities provide companies access to young human talent for relatively low costs and knowledge spillovers. On the other hand, real estate development on corporate STPs are, compared to university STPs, relatively faster due to different decision-making processes. This development pace and dedicated space for established companies could translate to a longer duration of stay on corporate STPs.

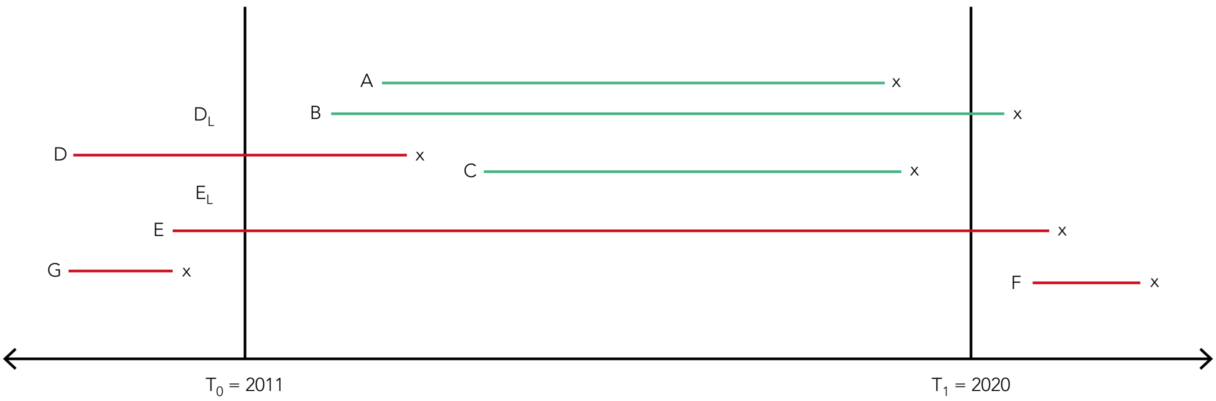
3 Sampling and results

3.1. Sampling procedure

There are many STP-like locations in the Netherlands. In this paper 27 different STPs are studied derived from the work by Buck Consultants International commissioned by the Dutch government. These STPs are widely accepted as the 'park-like' locations, in contrast to 'building-like' areas of innovation [xi]. The inclusion of all park-like STPs in the Netherlands that were active in the studied period improves representability of the findings (appendix A). These STPs vary among other things by degree of urbanisation, size and knowledge anchor. Consequently, these locations can be categorised into 13 university STPs (i.e., it houses the main university headquarter or university medical center) and 14 corporate STPs (non-university locations). Lastly, park-like STPs are geographically bound, which makes sampling companies straight-forward.

Within the geographical boundaries of the 27 STPs a set of company data is acquired from the Dutch Chambre of Commerce in the period 2011 – 2020 through the full zip codes (4 digits + 2 letters). The full zip code is the most detailed level of geographic data that is able to intersect STP areas and company data. As all companies are legally obligated to report to the Chambre of Commerce the sample for the analysis is quite robust. In order to study the duration of stay only company data is used that is observable within the studied period. See figure 1 for a schematic example of types of censored data [xii]. Company data such as type A and C are used as their entire duration of stay is observable. Type B is used, because their stay after T1 is irrelevant for this study. Company data such as D and E are not usable as this data is left-censored. As no data is available before or after the observed period, company data type G and F are excluded as well. In the observed period 11,251 STP companies are used for further analyses.

Figure 1. Types of censored data



3.2. Cluster analysis results

In line with the exploratory nature of this paper the elbow method is used to find the number of clusters in the dataset with a decreasing Sum of Squared Error. Here the optimal K number of clusters for the k-means cluster analysis should be five as the SSE does not decrease exponentially with additional clusters [xiii]. We did not opt for six clusters as the comprehensibility of the results will not increase.

Company variables are used to split the sample in clusters to factor in company heterogeneity. Variables include company size in number of employees on-location (size STP) and if applicable company size of the larger concern it is part of (company size), company age in years (age) and five STP-related business activities in accordance to NACE Rev. 2 (Human health and social work activities (Health), Manufacturing, Information and communication (IC), Other service activities, Professional, scientific and technical activities (Professional). Business activities variables are binary and within the dataset a company can only be active in one industry. None of the cluster variables showed high correlation with one another, i.e., exceeding 0.6 (appendix B) [xiv].

The three major cluster variables are in descending order age, company size and size STP. The business activity variables are relatively less important in distinguishing clusters (appendix C). Nonetheless, these variables serve to better understand the clusters. In table 1, the total sample and five clusters are shown and for ease of comprehensibility of cluster differences shades of color are added. As the k-mean technique only distinguishes clusters on their differences and in-clusters similarities the authors have labelled the five clusters based on their relative differences. These arbitrary labels are by no means conclusive for alle companies, but do reflect the most present company characteristics.

Table 1 Total sample and cluster comparison

	Total sample (11,251)	C1 (4,527) 'Mature'	C2 (3,179) 'Grown-up'	C3 (1,544) 'Scale-up'	C4 (1,418) 'Start-up'	C5 (583) 'IC services'
Variables	Mean	Mean	Mean	Mean	Mean	Mean
Age	13.7	14.3	13.4	13.6	12.6	13.6
Company size	511.9	541.1	491.2	594.5	317.5	653.1
Size STP	16.3	18.4	16.1	11.9	16.2	12.6
	%	%	%	%	%	%
Health	7%	6.9%	7.0%	6.6%	6.5%	6.0%
IC	12%	11.3%	11.1%	11.8%	13.0%	13.2%
Manufacturing	5%	5.4%	5.5%	4.5%	5.4%	5.0%
Other	15%	14.3%	14.8%	15.3%	15.6%	12.5%
Professional	27%	25.9%	27.1%	28.0%	26.7%	26.1%

C1 'Mature' (4,527/11,251) The largest group with the relatively oldest and largest on-site companies. These companies are most active in established business activities such as human health and social work, manufacturing and other service activities.

C2 'Grown-up' (3,179/11,251) In terms of characteristics this group is very similar to the 'mature' cluster, but relatively smaller and younger. Between size on location and age this cluster seems to be the second-most mature. Companies in this group are relatively more active in professional, scientific and technical activities.

C3 'Scale-up' (1,544/11,251) This cluster is relatively the smallest among the clusters, but not the youngest and mostly active in professional, scientific, technical and other related work.

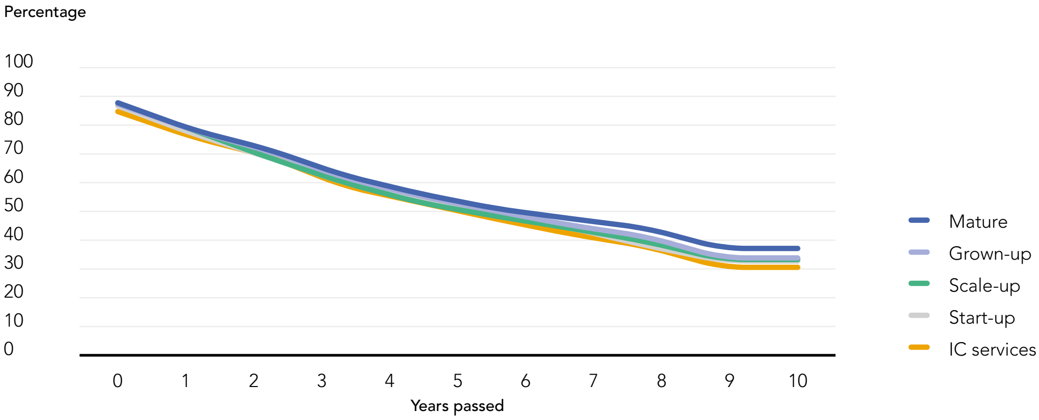
C4 'Start-up' (1,418/11,251) This cluster is the youngest and their activities are well-spread over all five business activities.

C5 'IC services' (583/11,251) The smallest cluster consists of companies with a relatively low employee count. Companies in this cluster often belong to a relatively large business group. Their signature business activity is information and communications, hence IC services.

3.3. Survival analysis results

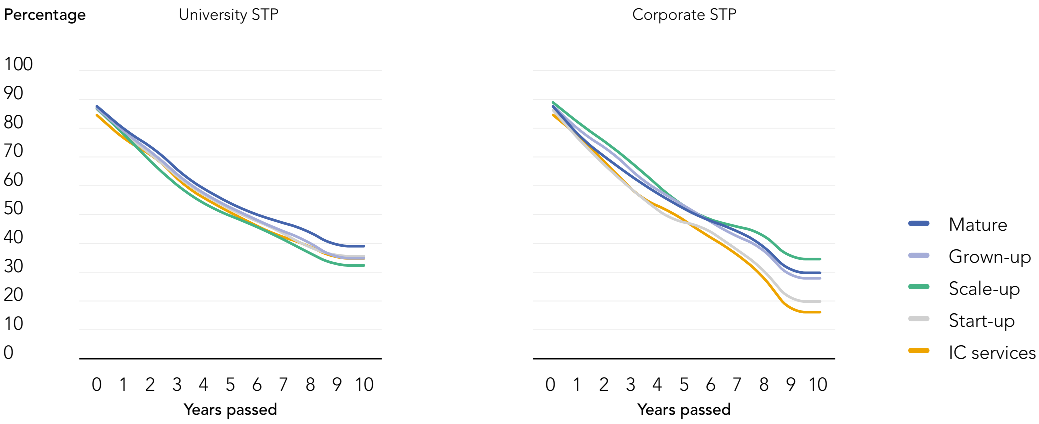
Among all STPs used in this study, the average duration of stay is 3.85 years through the Kaplan-Meier survival analysis. In figure 2 the five clusters are plotted in the years passed and the probability that a specific cluster stays on an STP. For example, there is around 55% probability that companies of cluster 3, 4 and 5 stay beyond four years. For cluster 1 and 2 this probability is higher. In the later years this gap between cluster 1 and 5 increases the most. The probability of the survivability curve does not start at 100%, because some companies are only present at T0. Independent on STP type, the 'mature' cluster have the highest stay rate of all clusters, while the 'IC services' cluster has the lowest survivability among all clusters. Overall, it seems that size, but also age have a positive effect on survivability.

Figure 2. Duration of stay cluster types on STPs



Comparing the results from the company clusters and STP types yields additional insights. Among the total sample of 11,251 companies, 75% are located on university STPs and 25% are located on their corporate counterpart. STP size does seems to matter for survivability. The average duration of stay on corporate STPs is 3.56 years, which is lower than on university STPs (3.94 years). Differences in survivability is noticeably larger among cluster types on corporate STPs. On corporate STPs, 'scale-up' companies are most likely to survive the longest among all cluster types. For university STPs, 'mature' are most likely to survive, while 'grown-up' companies have a similar survivability as 'scale-ups' and 'IC services'. Dutch park-like university STPs are located in more urbanised municipalities than corporate STPs (appendix A), providing more urban externalities and human talent.

Figure 3. Duration of stay cluster types on university and corporate STPs



4 Discussion and future research

STPs and areas of innovation play a pivotal role in shaping the future of the knowledge economy. With this paper we looked back to the period between 2011 and 2020 and delved into the survivability or stickiness of companies on corporate and university STPs. We used company data from all park-like STPs in the Netherlands, which increases generalisability for the Dutch context. The knowledge gap that we fill is to consider heterogeneity among resident companies [xv].

The objectives of companies in different business development phases are different [xvi]. Therefore, the business development phase is likely to affect the duration of stay of companies as locational needs differ. Through a cluster analysis we show that indeed younger and smaller companies have the lowest survivability rate among cluster types. Duration of stay on university STPs is on average longer than corporate STPs. More mature companies tend to survive longer on university STPs, while similar companies are more likely to leave corporate STPs sooner. This could be related to the roles that these knowledge anchors serve towards their resident companies. Universities play a more critical role in early business development phases with little room on campus to provide accommodation for established companies. University STP managers could collaborate with private real estate companies to develop single-tenant buildings for scale-ups, which in turn could attract more companies. In contrast, real estate decision-making on corporate STPs tend to be quicker and more space is available for expansion and single-tenant buildings. Survivability curves for the cluster types on corporate STPs are more varied than on university STPs and relatively more mature and larger companies tend to survive longer than younger counterparts. For corporate STP managers more attention is likely needed to accommodate the support for start-ups to thrive. For instance, additional effort towards incubator schemes and adequate support and training programs. On one hand, duration of stay of companies is tied to these organisations leaving the STP as the location does no longer fulfill their needs [xvii]. Future research should delve into the real estate context on STPs, which we currently did not take into account. For instance, the supply of facilities and services on each STP and their specific development strategy. In addition, the features of new and old locations of relocated companies should be compared. On the other hand, in the context of innovative start-ups, exits could be a result of an acquisition by other, larger companies. Therefore, in some cases, the exit of companies could be a good sign, which opens an avenue for future research into the factors that lead to the different types of exit. Nonetheless, from the perspective of STPs, the departure of companies often leads to some changes to the ecosystem's composition. In the end, STPs should create and maintain a robust community with collaboration opportunities and provide critical resources, such as R&D facilities and services, that are difficult to substitute and diminish the resident's need to depart.

5 Appendix

Appendix A STPs in the Netherlands

	STPs	Knowledge anchor	Urbanisation
University STPs	AMC Medical Business Park	University Medical Centre (UMC)	1
	Amsterdam Science Park	University	1
	Brightlands Maastricht Health Campus	UMC	1
	Healthy Ageing Campus Groningen	University + UMC	1
	Kennispark Twente	University	2
	Leiden Bio Science Park	University + UMC	1
	Mercator Science Park Nijmegen	University + UMC	2
	TU Delft Campus	University	1
	TU/e Campus	University	1
	Utrecht Science Park	University + UMC	1
	VU Campus Amsterdam	Universiteit + UMC	1
	Wageningen Campus	University	2
	Zernike Campus Groningen	University	1
Corporate STPs	Biotech Campus Delft	DSM	1
	Brainport Industries Campus Eindhoven	Various	1
	Brightlands Chemelot Campus	Various	2
	Brightlands Greenport Campus Venlo	BASF	2
	Brightlands Smart Services Campus Heerlen	APG	2
	Energy & Health Campus	Various	4
	High Tech Automotive Campus Helmond	Various	2
	High Tech Campus Eindhoven	Various	1
	High Tech Systems Park Hengelo	Thales	2

Note: Degree of urbanisation on municipality level, based on Statistics Netherlands (1=very high, 2=high, 3=somewhat, 4=low, 5=not urbanised)

Appendix B Correlation matrix clustering variables

	Size STP	Company size	Age	Professional	Health	Manufacturing	IC	Other
Size STP		0,08**	0,09**		0,04**	0,03*		-0,03**
Company size	0,08**		0,04**	-0,03**		0,02*	-0,03**	-0,04**
Age	0,09**	0,04**		-0,08**	0,04**	0,02*	-0,13**	0,15**
Professional		-0,03**	-0,08**		-0,16**	-0,14**	-0,22**	-0,25**
Health	0,04**		0,04**	-0,16**		-0,06**	-0,10**	-0,11**
Manufacturing	0,03*	0,02*	0,02*	-0,14**	-0,06**		-0,09**	-0,10**
IC		-0,03**	-0,13**	-0,22**	-0,10**	-0,09**		-0,15**
Other	-0,03**	-0,04**	0,15**	-0,25**	-0,11**	-0,10**	-0,15**	

Note. Significant on $p = 0.05$* or 0.001** level (2-tailed).

Appendix C Cluster variable importance

Variables	C1	C2	C3	C4	C5
Age	31.4	31.3	33.0	30.0	34.0
Company size	28.5	29.4	28.2	28.8	25.9
Size STP	25.2	24.5	22.0	22.9	23.1
Professional	4.9	3.7	5.0	6.0	5.5
Manufacturing	2.8	2.7	2.9	4.5	1.9
Other	2.3	2.1	3.2	2.8	4.7
Health	2.8	3.2	3.0	2.7	2.4
IC	2.2	3.1	2.7	2.2	2.4
	100	**100**	**100**	**100**	**100**

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