

DECLINE OF TOWN AND VILLAGE CENTRES? DELINEATION AND ANALYSIS OF HISTORIC CENTRES IN UPPER AUSTRIA BASED ON THE FRANCISCAN CADASTRE

DOMINIK EBENSTREIT, Lienz / Vienna [Wien]*

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Summary

This article analyses the condition and development of historic town and village centres in Upper Austria and closes a research gap in the empirical recording of these central settlement areas. Based on a semi-automated delimitation using the Franciscan cadastre ('Franziseischer Kataster') (1817–1861) and statistical data from 2001 and 2018, a methodologically robust procedure was developed that makes historical centres morphologically and functionally comparable.

The results show an area of tension between structural redensification and social depopulation: despite rising building and housing numbers, most town and village centres recorded declining populations, increasing vacancy rates and the loss of their commercial functions. The shift towards a (semi-)public service sector and the erosion of architectural heritage are particularly characteristic of this development in peripheral regions. A cluster

* Dominik EBENSTREIT, M.A., M.Sc., self-employed regional planner and cartographer; lecturer at the Department of Geography and Regional Research, University of Vienna, Universitätsstraße 7/5, A-1010 Vienna, Austria. – E-Mail: Dominik.Ebenstreit@univie.ac.at

analysis identifies five types of historic town and village centres with widely diverging development paths – from dynamic centres of densification to structurally endangered centres.

The study illustrates that historic town and village centres are neither static relics nor self-sustaining resilient spaces. Their future viability depends on integrated, data-based and type-specific strategies that take revitalisation, mobility and building culture into account in equal measure.

Keywords: Town centres, village centres, structural analysis, delineation, Franciscan cadastre, image-classification, cluster analysis, Upper Austria

Zusammenfassung

NIEDERGANG VON STADT- UND ORTSKERNEN? ABGRENZUNG UND ANALYSE HISTORISCHER ORTSKERNE IN OBERÖSTERREICH AUF BASIS DES FRANZISZEISCHEN KATASTERS

In der vorliegenden Studie werden der Zustand und die Entwicklung historischer Ortskerne in Oberösterreich analysiert und eine Forschungslücke in der empirischen Erfassung dieser zentralen Siedlungsräume geschlossen. Auf Basis einer teilautomatisierten Abgrenzung der historischen Ortskerne mit Hilfe des Franziszeischen Katasters (1817–1861) und statistischer Daten aus den Jahren 2001 und 2018 wurde ein methodisch belastbares Verfahren entwickelt, das historische Zentren morphologisch und funktional vergleichbar macht.

Die Ergebnisse zeigen ein Spannungsfeld zwischen baulicher Nachverdichtung und sozialer Entleerung: Trotz steigender Gebäude- und Wohnungszahlen verzeichneten die meisten Ortskerne in Oberösterreich Bevölkerungsrückgänge, zunehmenden Leerstand und den Verlust ihrer Handelsfunktionen. Der Wandel hin zu einem (halb-)öffentlichen Dienstleistungssektor und die Erosion des baukulturellen Erbes prägen diese Entwicklung besonders in peripheren Regionen. Eine Clusteranalyse identifiziert fünf Typen historischer Ortskerne mit stark divergierenden Entwicklungspfaden – von dynamischen Verdichtungscentren bis zu strukturell gefährdeten Kernen.

Die Studie verdeutlicht, dass historische Ortskerne weder statische Relikte noch selbsttragende resiliente Räume sind. Ihre Zukunftsfähigkeit hängt von integrierten, datenbasierten und typenspezifischen Strategien ab, die Revitalisierung, Mobilität und Baukultur gleichermaßen berücksichtigen.

Schlagwörter: Ortskerne, Dorfkerne, Stadtkerne, Strukturanalyse, Abgrenzungsverfahren, Franziszeischer Kataster, Bildklassifikation, Clusteranalyse, Oberösterreich

1 Introduction

Town and village centres are regarded as central locations for social, functional and cultural interaction (POWE 2020) and have been the focus of spatial science and planning policy considerations for decades. Recently, the discussion about their stabilisation and revitalisation has gained considerable importance in spatial planning policy (HOSPERS 2017). In mission statements and technical recommendations, terms such as

redensification, inner-before-outer development and vacancy management are established as the cornerstones of sustainable spatial development. These terms refer to a political and planning discourse that emphasises the functional and symbolic value of town and village centres as spaces that create identity (GUSHCHIN and DIVAKOVA 2019), while at the same time their importance is steadily declining in favour of other settlement areas (ARL 2020).

The transformation of these centres is the result of complex interactions between social, economic and spatial structural processes. Phenomena such as digitalisation, structural change in retail, changing mobility patterns and demographic ageing are leading to profound shifts in the functional structure of settlement areas (MENSING 2019; VLP-ASPAN 2016). While historic town and village centres have functioned as economic, administrative and cultural hubs for centuries, they are now increasingly facing competition from suburban and ‘de-spatialised’ centres (especially the internet), which, at least subjectively, have the upper hand in people’s everyday lives (ARL 2020). The result is a loss of function and vitality, which in many communities is accompanied by growing vacancy rates, declining mixed use and socio-spatial monofunctionality (HOSPERS 2017).

Against this backdrop, the question of the actual condition and development trends of historic town and village centres is once again becoming the focus of spatial research. Despite the high level of political attention and numerous support programmes, there is still no uniform empirical basis for systematically identifying and defining historic town and village centres and comparing their structural characteristics (PISSOURIOS 2014; MOL-LAY et al. 2018). The lack of reliable data makes it difficult to formulate spatial planning measures and evaluate existing strategies.

This research gap forms the starting point for the study, which uses the example of the federal state of Upper Austria to carry out a semi-automated delimitation and subsequent structural analysis of historic town and village centres. Methodologically, the study is based on the ‘Franciscan cadastre’ (*Franziszzeischer Kataster*) as a historical mapping basis and on statistical data from 2001 and 2018. The aim was to develop a methodologically robust set of tools for identifying historic centres and, building on this, to describe key trends and challenges facing these areas in the 21st century.

The study therefore pursues three research questions:

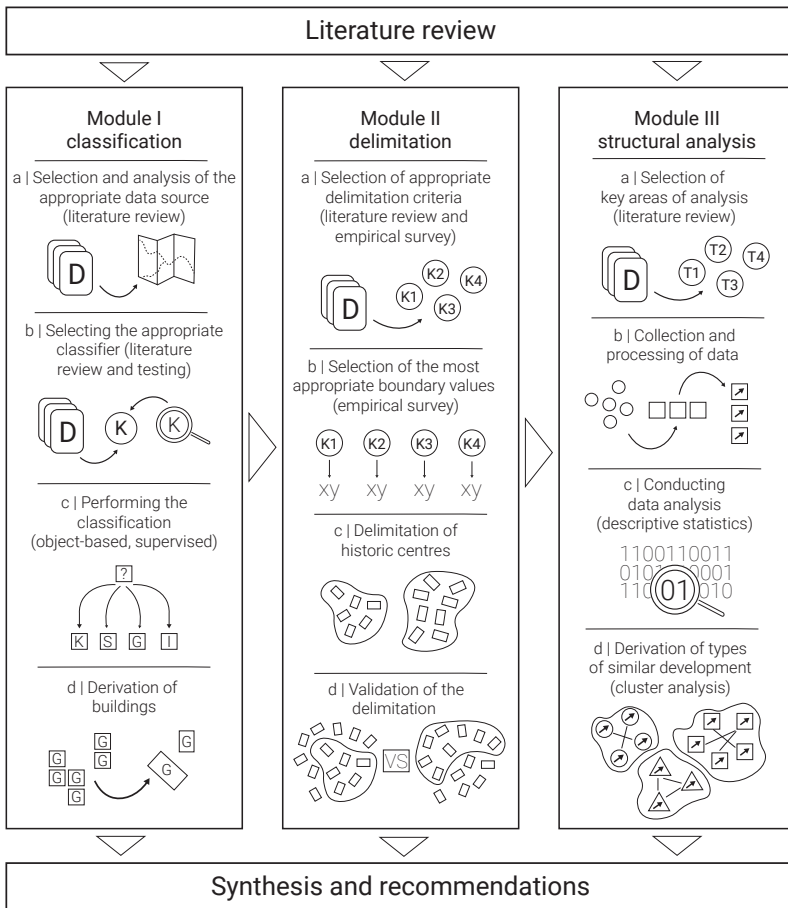
- (1) What are the potential benefits and limitations of a semi-automated delineation of historic town and village centres based on the Franciscan cadastre?
- (2) What socio-economic, functional and spatial developments characterise the historic town and village centres of Upper Austria, and how can these developments be systematically classified?
- (3) What recommendations for action can be derived from the empirical findings for evidence-based centre policy at state and federal level?

2 Theoretical and Conceptual Framework

The delimitation of town and village centres has long been a subject of academic interest (PISSOURIOS 2014). As town and village centres do not have clear spatial or data-based

boundaries separating them from their surroundings (WURM et al. 2019), there have been many different attempts to define these ‘fuzzy spaces’ (e.g. SUN et al. 2016; CHESHIRE et al. 2018; XIE et al. 2021; MARAKAKIS et al. 2022; SOARES et al. 2022).

The methodologies applied differ significantly but can be broadly categorised into morphological and functional delimitation (SOARES et al. 2022). Functional delimitations focus on the functions of town and village centres and define them on the basis of existing functions (e.g. the presence of businesses and shops, increased presence of people). Morphological definitions focus on the built environment (e.g. building density). However, there are significant limitations to existing studies. The current focus is primarily on the delimitation of individual case studies and on larger cities. Smaller towns or villages, by contrast, are not considered in the current literature. Nor are there any studies on structured



Source: Author. Graphic: Own compilation, own design.

Figure 1: Methodological design of the study

data analysis of these town and village centres. However, these are particularly relevant to the planning and development of rural areas (SOSZYŃSKI et al. 2021).

A structured delimitation is above all necessary for a comparative statistical analysis in order to establish comparability and identify spatial trends. Furthermore, this delimitation can be linked to policies and funding that support and strengthen the centres (SOARES et al. 2022). The study therefore took the approach of delimitate town and village centres based on morphological features and historical building structures that can be interpreted as ‘material relics’ (SCHÖNWANDT 2001; WEICHHART 2018) of social and functional centrality.

This approach contrasts with the numerous attempts at functional delimitation in practice and was deliberately chosen in order to rule out distortions in the statistical analysis of town and village centres. For example, the functional delimitation does not include historic town and village centres that have already been ‘degraded’ (SZCZEPAŃSKA and PIETRZYK 2025). Similarly, variables included in the delimitation can no longer be analysed, as they already formed the basis for the delimitation.

The methodological approach of the study is therefore based on a multi-stage design that combines theoretical, cartographic-morphological and statistical-analytical approaches (see Figure 1). This made it possible to delineate a very large number of town and village centers – a method that had hardly been used until now. The following sections describe the method for delimitation and analysing town and village centres, using the federal state of Upper Austria (Austria) as an example.

3 Delineation of Town and Village Centres

3.1 Methods

The delineation of historic town and village centres was based on the *Franziszeischer Kataster* (‘Franciscan cadastre’) (1817–1861), a historical cadastral survey of the former Habsburg Monarchy (see Figures 2 and 3). This dataset represents one of the most detailed and comprehensive spatial documentations of pre-industrial settlement structures in Central Europe. It includes high-resolution information on buildings, parcels, land use and transport infrastructure and was digitised and georeferenced by the federal state of Upper Austria. The geometric precision and thematic richness of the cadastral sheets allow for the reconstruction of historical settlement morphologies, many of which still influence contemporary spatial structures.

The methodological approach follows a GIS-based, semi-automated object-oriented workflow that combines elements of historical map classification with spatial analysis. The choice of a semi-automated procedure is rooted in both theoretical considerations and empirical constraints.

From a methodological perspective, the classification of historical maps can be differentiated along three main dimensions (MATHER and KOCH 2011; DE LANGE 2020):

- (1) degree of automation (supervised versus unsupervised)
- (2) classification unit (pixel-based versus object-based), and
- (3) classification algorithm.

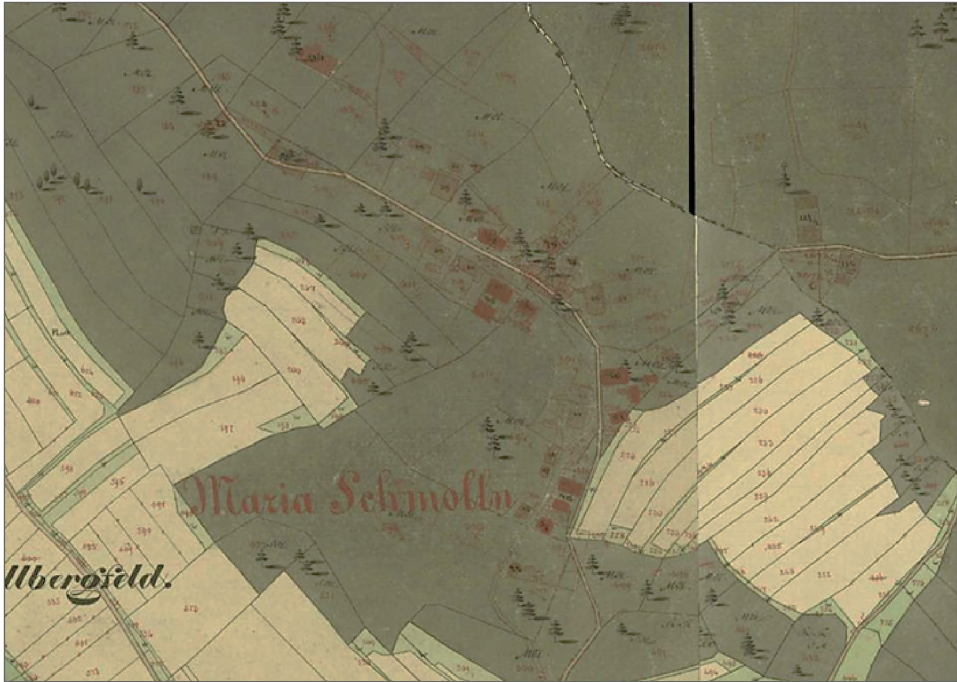


Source: Upper Austrian Provincial Archives [Oberösterreichisches Landesarchiv], Austrian State Archives [Österreichisches Staatsarchiv]

Figure 2: Example from the Franciscan Cadastre [*Franziszischer Kataster*]: A typical cut from the original file ('Urmappe'): Buildings in bright red (stone buildings), dark red (public buildings), and yellow (farm buildings). Borders in red and yellow, roads in brown and pink.

Existing literature indicates a general preference for supervised, object-based approaches, as they allow the integration of spatial context (e.g. geometry, neighbourhood relations) and yield more coherent classification results compared to purely pixel-based methods (ZATELLI et al. 2019). In particular, object-based methods are advantageous when extracting discrete entities such as buildings, as they reduce noise effects (e.g. "salt-and-pepper") and enable the use of morphological characteristics (DE LANGE 2020).

However, advanced supervised approaches such as *Support Vector Machines* or *Deep Learning* require extensive and well-distributed training datasets. For neural networks, several thousand labelled objects per class are typically necessary to achieve robust results (GOODFELLOW et al. 2018). Due to the absence of such training data for the *Franziszischer Kataster* ('Franciscan cadastre') these methods were not applicable in this study. Instead, a semi-automated classification approach was implemented, combining rule-based extraction with manual validation.



Source: Upper Austrian Provincial Archives [Oberösterreichisches Landesarchiv], Austrian State Archives [Österreichisches Staatsarchiv]

Figure 3: An extreme example from the Franciscan Cadastre [*Franziszeischer Kataster*]: The settlement was not established until after the original map had been drawn up; buildings and plots were added later in; the map is badly yellowed

The starting point of the analysis was the georeferenced raster dataset of the cadastral sheets. Pre-processing steps included visual inspection, correction of georeferencing inaccuracies and the handling of typical artefacts of historical maps such as discoloration, scanning noise and symbol interference. These issues are known to significantly affect classification performance and therefore require careful consideration in historical GIS workflows.

The selection of classification parameters was not arbitrary but based on a combination of literature review and empirical testing. To ensure robustness, test classifications were conducted on a representative sample area (approximately 3×3 km near the city of Wels), which includes a wide range of land-use classes and typical artefacts of the cadastral maps. This approach enabled the systematic evaluation of classification performance under realistic conditions.

The quality of classification results was assessed using established validation techniques such as confusion matrices, which compare classified outputs with reference data and allow for the identification of systematic misclassifications (ROTZENSTEIN and

KARNIELI 2011). This validation step was crucial for refining parameters and ensuring the reliability of the final delineation.

The comparative validation of the classification approaches reveals that the pixel-based *Support Vector Machine* (SVM) model can partially compete with the object-based approach but does not outperform it overall (see Figure 4). The pixel-based model achieved a notably high class-specific accuracy of 92 percent for stone buildings, exceeding the performance of the object-based model in this class (82 percent). However, across all other classes, the object-based approach consistently produced higher accuracy values, in some cases substantially so.

The exclusion of discoloured map areas (yellowing artefacts) during the training phase led to a marked improvement in model performance for both approaches, indicating the importance of pre-processing steps. Within the pixel-based variants, the model excluding such artefacts clearly outperformed those including additional predefined classes such as boundaries or roads (which are red and yellow), as the latter resulted in systematic misclassification of linear features as buildings (which are also red and yellow). Although this variant requires post-processing to remove falsely classified linear elements, this task proved significantly less time-consuming than reconstructing omitted buildings in alternative variants.

In contrast, the object-based approach showed limitations in distinguishing geometrically similar features: more than 100 buildings (approximately 24 percent) were misclassified in one variant and over 200 buildings (around one-third of all cases) in another. This highlights that geometric similarity between fragmented boundary lines and large building structures can reduce classification accuracy even in object-based workflows. Overall, despite some advantages of the pixel-based model, particularly in specific classes, the object-based approach was selected as the preferred method due to its higher overall robustness and lower post-processing effort.

After applying the most suitable classification model and deriving building outlines, all buildings were then manually reviewed once again, misclassifications (such as boundaries classified as buildings) were removed, and buildings that had not been classified were added. This constituted the largest non-automated workload. Only then were the historic centres derived through a multi-stage process:

(1) *Identification of main buildings*

Main buildings were distinguished from ancillary buildings based on their footprint area ($> 35 \text{ m}^2$). This threshold was derived empirically and reflects typical minimum sizes of residential or economically relevant buildings in historical cadastral records (HECHT 2014; HARIG et al. 2014).

(2) *Identification of building clusters*

Extracted buildings were aggregated into clusters using a distance-based approach ($\leq 35 \text{ m}$ distance). This parameter is based on average building distances observed in contemporary settlement structures in Upper Austria and serves as a proxy for functional and morphological cohesion.

Pixel based

		with yellowing			without yellowing		
		var. I	var. II	var. III	var. I	var. II	var. III
producer's accuracy	stone buildings	90%	65%	46%	92%	67%	47%
	farm buildings	55%	57%	43%	74%	65%	56%
	borders yellow	---	74%	65%	---	73%	63%
	borders red	---	62%	58%	---	67%	62%
	streets	---	---	91%	---	---	91%
user's accuracy	stone buildings	86%	62%	57%	88%	63%	53%
	farm buildings	15%	10%	8%	87%	67%	63%
	borders yellow	---	70%	71%	---	78%	81%
	borders red	---	60%	70%	---	61%	72%
	streets	---	---	63%	---	---	63%
detected area (%)	stone buildings	---	---	---	68%	---	---
	farm buildings	---	---	---	60%	---	---
	borders yellow	---	---	---	48%	---	---
	borders red	---	---	---	50%	---	---
	streets	---	---	---	36%	---	---
overall accuracy		66%	65%	65%	74%	70%	69%
Kappa		0,64	0,62	0,62	0,71	0,68	0,66
unclassified buildings		---	---	---	100/603	---	---
overhanging surface		---	---	---	23%	---	---

Object based

		with yellowing			without yellowing		
		var. I	var. II	var. III	var. I	var. II	var. III
producer's accuracy	stone buildings	83%	81%	77%	82%	83%	79%
	farm buildings	82%	43%	86%	86%	76%	76%
	borders yellow	---	86%	86%	---	88%	85%
	borders red	---	76%	62%	---	64%	67%
	streets	---	---	89%	---	---	89%
user's accuracy	stone buildings	85%	71%	69%	89%	71%	75%
	farm buildings	39%	10%	24%	91%	81%	87%
	borders yellow	---	70%	77%	---	76%	89%
	borders red	---	83%	88%	---	84%	90%
	streets	---	---	70%	---	---	70%
detected area (%)	stone buildings	---	---	---	86%	87%	88%
	farm buildings	---	---	---	72%	74%	74%
	borders yellow	---	---	---	50%	72%	78%
	borders red	---	---	---	46%	56%	50%
	streets	---	---	---	6%	20%	79%
overall accuracy		73%	68%	68%	76%	73%	72%
Kappa		0,70	0,65	0,65	0,73	0,70	0,70
unclassified buildings		---	---	---	49/603	42/603	36/603
misclassified buildings		---	---	---	---	142/603	204/603
overhanging surface		---	---	---	28%	57%	34%

Source: Author. Data: Own calculations, own representation

Figure 4: Results of the method comparison regarding class variants, classification methods and the identification of test areas within yellowed patches. Some parameters have been calculated only for selected models.

(3) *Integration into the current settlement system*

Only clusters located within present-day settlement areas were considered. This step ensures spatial relevance and excludes historically documented but currently non-existent or functionally irrelevant structures.

(4) *Minimum size criteria*

To qualify as a town or village centre, clusters had to meet at least one of the following thresholds:

- a minimum of 10 buildings, or
- a total building footprint of at least 1,700 m².

These thresholds were derived from empirical observations and correspond to approximately ten times the average building footprint, ensuring a minimum level of structural density.

(5) *Exclusion of mono-functional large structures*

Large complexes with singular functions (e.g. castles, barracks or industrial facilities) were excluded, as they do not represent multifunctional settlement centres.

(6) *Exclusion of heavily transformed areas*

Areas that have been significantly altered or completely overwritten by modern developments (e.g. industrial expansion such as the voestalpine steelworks in Linz) were excluded to maintain historical continuity.

3.2 Results

The result was a comprehensive identification of 731 historic town and village centres in Upper Austria. Of these, 360 were classified as town and village centres in the main settlement of the municipality, 288 as town and village centres in other parts of settlements and 83 as other historic settlements. These boundaries served as the spatial basis for the subsequent structural analysis.

In a final step, the results were validated on the basis of alternative delimitations. By cross-referencing the centre zone designations from the local land use plans, it was determined how closely the defined historical town and village centres corresponded to the recently defined town and village centres. It was found that there was a very high degree of matching, confirming that the delimitation method using the Franciscan cadastre has considerable potential – especially as a starting point for participatory town and village centre delimitation.

3.3 Potential Benefits and Limitations of the Approach

Despite the robustness of the approach, several limitations must be acknowledged. Historical cadastral maps exhibit varying levels of accuracy and are affected by ageing

processes, digitisation artefacts and inconsistencies in representation. Furthermore, the absence of large training datasets limits the applicability of advanced machine learning methods, necessitating a semi-automated approach with manual intervention.

Nevertheless, the chosen methodology represents a pragmatic balance between automation and interpretability, allowing for a reproducible and scalable delineation of historical settlement centres across large study areas. Overall, the delimitation method yielded good results and offers both potential and limitations.

The main advantages are that the cadastre has a very high (geometric) resolution in light of its age and is available for large parts of Central Europe (all areas that were part of the Habsburg Monarchy at the time). This allows for large-scale comparisons across federal state and even national borders. The method is also particularly suitable for subsequent statistical analysis, where functional criteria would introduce bias. The standardised approach, on the other hand, is primarily beneficial for funding bodies that require a uniform method of classification in order to allocate funding fairly. Thanks to its semi-automated nature, the method also saves time and, consequently, financial resources. Although more labour-intensive than raster-based approaches, the method enables a substantially more precise delineation of town and village centres, which would otherwise be inadequately captured by coarse grid resolutions given that the median size of identified centres is only about 4 ha.

Nevertheless, limitations have also emerged with regard to the methodological approach. Town centres are still relational, historically and socially formed areas of interconnection with fluid transitions, whose material manifestations such as buildings, streets and squares merely represent the visible expression of these processes (Löw 2018, p. 7). These spaces, which are automatically defined on the basis of their morphology or functions, must therefore, above all, be subject to feedback from the local population when it comes to the planning and development of these centres (ÖROK 2019). Semi-automated delimitations are not the end point but can be a starting point for the necessary social negotiation processes that ultimately lead to the final delimitation.

Furthermore, a delimitation such as the one carried out here is only possible where historical maps of good quality and spatial resolution are available. This is not the case in large parts of the world.

4 Main Characteristics of Town and Village Centres in Upper Austria

4.1 Current Visions for Town and City Centres in Austria

To characterise and examine the historic town and village centres in Upper Austria, four bundles of characteristics and 45 indicators (see Table 1) were defined, which were derived from the evaluation of 14 spatial planning concepts and scientific literature from Austria. These thematic areas reflect the current collective vision for the future of town and village centres in Austria.

(1) Town and village centres as (moderately) densified centres:

(Historic) town and village centres should continue to form the focal point of settlement and the vital centre of the community in the future. Indicators used (simplified): densification and building structure – measured by building density, the proportion of inhabited buildings, the vacancy rate and the age structure.

(2) Town and village centres as multifunctional centres:

(Historic) town and village centres will continue to be characterised by their mixed use in the future. Living, working, everyday shopping, leisure and mobility are concentrated in these central, functional interlinked areas. Indicators used (simplified): diversity of industries, proportion of inhabited buildings, number of employees in the industries.

(3) Town and village centres as easily accessible hubs:

Town and village centres should be easily accessible hubs – whether on foot, by public transport or by bike. Indicators used (simplified): accessibility on foot, accessibility by bike, accessibility by public transport, frequency of public transport services.

(4) Town and village centres as protected architectural heritage:

Town and village centres are places of identification, primarily due to their historic buildings. This architectural heritage must therefore be protected. Although densification is desirable in this area, it must be carried out with sensitivity to the existing buildings. Indicators used (simplified): Proportion and number of historic buildings.

4.2 Methodological Approach

To analyse town centres and their development, current statistical data (from Statistics Austria and other public data sources) was retrieved based on these four subject areas and 45 indicators, particularly from 2001 and 2018 (see Table 1). The data was either available

Dynamic Indicators (2001–2018)	Static Indicators (2018)
1 Development of primary residences (%)	21 Population density / ha of building land (population/ha)
2 Development of the number of buildings (%)	22 Building density / ha of building land (buildings/ha)
3 Development of the number of residential buildings (%)	23 Housing density / ha of building land (dwellings/ha)
4 Development of housing occupancy (%)	24 Housing occupancy (persons)
5 Development of the number of households (%)	25 Households per dwelling (households)
6 Development of household budgets per dwelling (%)	26 Undeveloped area in building land (%)

Dynamic Indicators (2001–2018)	Static Indicators (2018)
7 Development of housing vacancy rates (flats minus households) – estimates (%)	27 Newly built flats per newly built residential building – Estimators (flats)
8 Development of the number of flats per residential building (flats/residential buildings)	28 Flats without primary residence in all Flats – Appraisers (flats)
9 Trend in the number of families with at least one child (%)	29 Families with at least one child per household (%)
10 Trend in the number of families with at least one child (%)	30 Percentage of buildings constructed after 1980 (%)
11 Development of the Herfindahl Index (Index)	31 Number of sectors (industries)
12 Development of employment figures (employees) excluding the primary sector (%)	32 Employees (employees) excluding primary sector per inhabitant (employees/inhabitant)
13 Growth in retail employment (%)	33 Herfindahl Index (Index)
14 Development of employment in the gastronomy and accommodation sector (%)	34 Employees in retail per inhabitant (employees/inhabitant)
15 Development of employment in finance and ITC (%)	35 Employees in the gastronomy and accommodation sector per inhabitant (employees/inhabitant)
16 Development of employment in other services (%)	36 Employees in the (semi-)public sector per inhabitant (employees/inhabitant)
17 Development of employment in the (semi-)public sector (%)	37 Maximum value (MAX) of accessibility on foot (accessible buildings)
18 Development of employment in goods manufacturing (%)	38 Maximum value (MAX) of accessibility by bicycle (accessible buildings)
19 Development of historic buildings up to the year of construction 1919 (%)	39 Average value (AVG) of accessibility on foot (accessible buildings)
20 Development of the proportion of historic buildings constructed before 1919 (%)	40 Average value (AVG) of accessibility by bicycle (accessible buildings)
	41 MAX public transport quality classes (class)
	42 Average public transport quality classes (class)
	43 Residents per departure
	44 Dominance of the best bus/train stop (%)
	45 Percentage of historic buildings (%)

Source: Author. Own compilation

Table 1: Overview of all 45 indicators considered in the analysis

as spatial data or was retrieved from official statistics for each submitted polygon. This included demographic, socio-economic and infrastructural indicators at municipal level or as a geo-dataset. By combining these two data levels – historical morphology and current structural parameters – it was possible to record the current situation and present-day development of historic town and village centres and to draw conclusions about the overall condition of historic town and village centres in Upper Austria.

All indicators were calculated for the years 2001 and 2018 in order to be able to show any changes. Since the development of town and village centres also depends on their spatial context, comparative values were calculated in each case. These comparative values were calculated from the total municipal value with the subtraction of the value for the town and village centre(s). In the analysis, the town and village centres were therefore always compared with the rest of the municipality.

A cluster analysis (Ward's method, Euclidean distance with prior principal component analysis) was then carried out to identify types of similar development. Clustering enabled the town and village centres to be grouped according to development dynamics and areas of weakness. Due to confidentiality requirements when retrieving very small polygons, it was not possible to collect data from official statistics for all centres. The structural analysis was only carried out for those historic town and village centres for which data could be provided for all variables – a total of 265 historic centres.

4.3 Results of the Data Analysis

The empirical study of the 265 historical town and village centres analysed in Upper Austria reveals a complex, regionally differentiated picture of structural and functional developments. The results are presented below on the basis of the four defined thematic areas of analysis. In addition, cluster analysis identified five types of similar development, which are explained in more detail in the next section.

Town and village centres as densely populated centres?

Between 2001 and 2018, the historic centres of Upper Austria experienced ambivalent development: despite measurable redensification – for example, a 4 percent increase in the number of buildings and a 26 percent increase in the number of dwellings – the median population declined by around 6 percent, and in 60 percent of the centres by even more. While the remaining municipal areas recorded average growth of 6.5 percent, the historic centres lost not only population (–3 percent on average) but also families with children (–20 percent), indicating an ageing and depopulation of the centres.

At the same time, the average vacancy rate rose by around 14 percentage points to almost a quarter of all residential units (compared to 9 percent in the rest of the municipality), illustrating the so-called “vacancy-new construction paradox”: Densification took place without leading to an increase in population numbers. Peripheral regions were particularly affected, while centres with a high degree of distance dominance – such as Linz and Braunau – remained comparatively stable. Although structural densification did indeed take place in many historic town and village centres – as evidenced by the increase

in buildings, flats and residential units – this did not lead to functional or demographic densification. The town and village centres thus became denser in terms of construction, but not in social terms.

Town and village centres as multifunctional centres?

Between 2001 and 2018, historic town and village centres underwent a significant functional change: while overall employment rose slightly (+2 percent), growth lagged far behind that of the remaining municipalities (+30 percent), and in almost half of the centres, the number of employees actually declined. The retail sector was particularly hard hit, losing jobs in 70 percent of centres and increasingly losing its importance as a defining component of local economic activities. At the same time, the diversity of industries declined and the concentration on a few sectors – primarily public administration, education, health, gastronomy and accommodation – increased, indicating increasing functional one-sidedness.

Although the historic town and village centre remains a relevant place of work, its economic multifunctionality is declining and increasingly dependent on the (semi-)public sector. Increasing specialisation, the decline in revitalising retail and service functions, and growing vacancy rates are also reducing the quality of life. Most historic town and village centres have therefore evolved from formerly diverse supply and employment centres into functionally limited locations with a focus on the public and social sectors.

Town and village centres as easily accessible hubs?

An analysis of the accessibility of historic town and village centres shows that, despite functional and structural changes, they can still be considered relatively easy to reach. Around 60 percent of historic centres are the most easily accessible areas within their municipalities on foot. Around half of them are also easily accessible by bicycle. This means that their central location within the settlement structure remains a significant locational advantage, particularly with regard to climate-friendly mobility. Regarding public transport, however, the picture is more nuanced: although town and village centres generally have better accessibility than the rest of the municipality, only around 45 percent of centres meet the minimum level of accessibility required in strategy papers.

Peripheral centres in particular perform significantly better in this respect than those in central locations or in the vicinity of Linz, where the relocation of stops and dynamic settlement developments have weakened the historical town and village centre location. Despite these differences, the data shows that public transport provision remains above average. Town and village centres in Upper Austria can therefore still be considered easily accessible centres, albeit with limitations in terms of public transport connections.

Town and village centres as protected architectural heritage?

The study on the architectural development of historic town and village centres shows that, despite moderate redensification, the preservation of historic buildings is not guaranteed across the board. Between 2001 and 2018, an average of around 5 percent of historic buildings were lost, with two-thirds of the town and village centres studied losing significantly more. In the most severely affected centres, one in ten historic buildings

disappeared, reducing the proportion of historic buildings in the total building stock by an average of 17 percentage points to only about one in five buildings. The loss was particularly distinctive in centres of minor central importance, where demolition and redensification with modern new buildings led to visible structural changes.

Although the proportion of historic buildings in town and village centres remains higher than in the rest of the municipality, the trends point to a progressive erosion of the architectural heritage – whether through active demolition in dynamic regions or through decay in peripheral locations. Despite the existing historical substance and selective conservation efforts, many town and village centres are therefore at risk of losing their architectural character.

5 Classification of Historic Town and Village Centres

The cluster analysis summarises the diverse developments of Upper Austria's historic town and village centres into five characteristic groups, which highlight different challenges and development paths (see Figure 5).

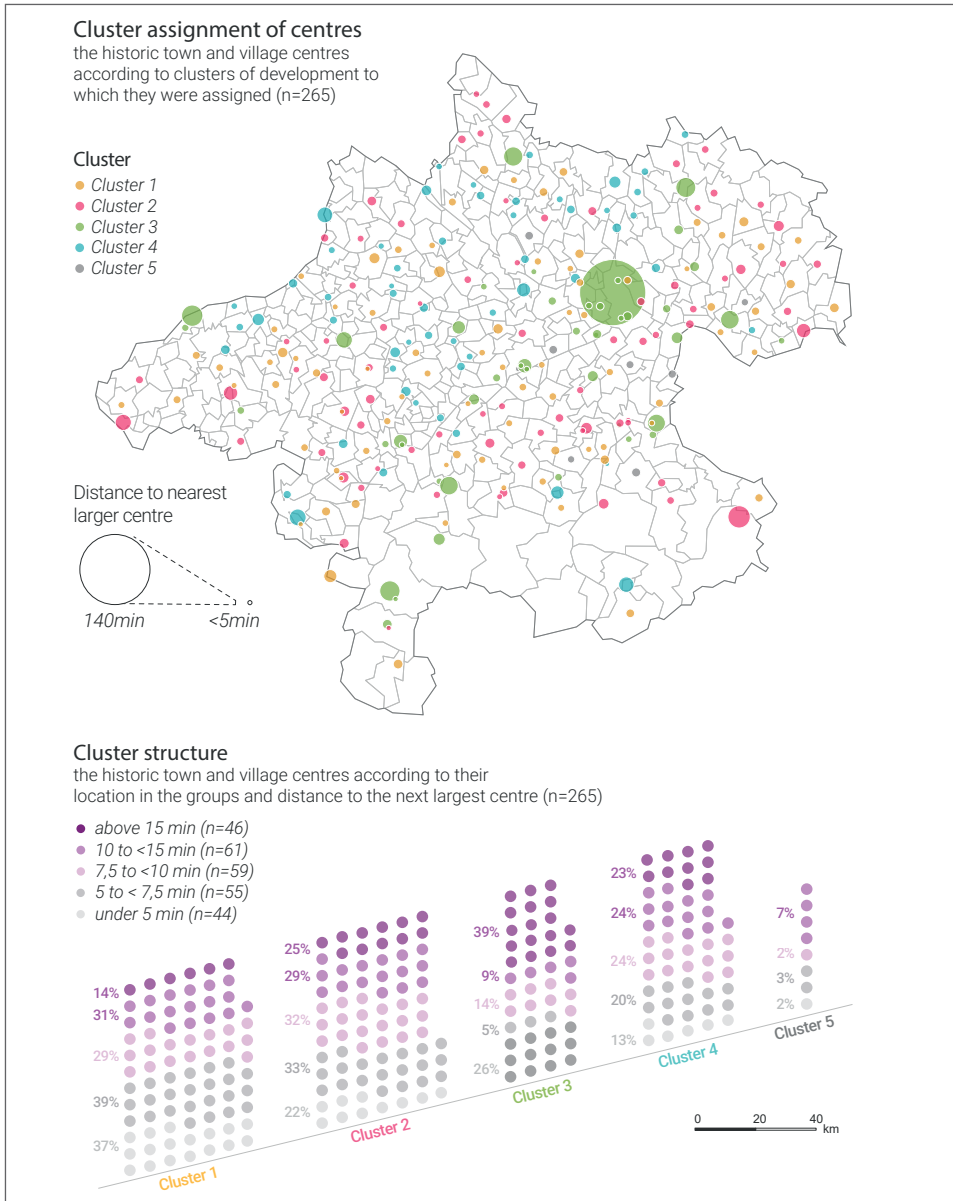
Cluster 1 comprises those centres which, despite poor accessibility on foot and by public transport, have experienced extremely positive economic development. They function as lively places of work and supply, whose central task in future will be to improve accessibility.

Cluster 2, on the other hand, represents the problem group: Between 2001 and 2018, these town and village centres lost a significant amount of population (–15 percent) as well as jobs (–15 percent) and functions. The decline is particularly pronounced in trade and families, indicating structural ageing and functional impoverishment. These centres are mainly concentrated in the peripheral regions.

Cluster 3 is characterised by excellent public transport connections but poor walkability. These mostly larger city centres or suburban centres around the Upper Austrian capital of Linz are experiencing moderate growth in population and employment but are suffering from significant structural change in the retail sector.

Cluster 4 is characterised by stagnating or declining demographic and economic developments, but at the same time good accessibility within the community on foot. The challenges here lie in stabilising incipient negative trends in order to prevent further decline. Geographically, these centres are mainly found in the Innviertel and western Mühlviertel regions.

Cluster 5, the smallest group, brings together the few town and village centres in the greater Linz-Steyr area that have undergone exceptionally high levels of redensification, with growth of over 90 percent in primary residences and over 100 percent in households in some cases. This densification has been accompanied by rising employment figures but raises questions about architectural and structural compatibility and the preservation of the historic town and village scape.



Source: Author. Own calculations, own representation

Figure 5: Historic town and village centres by cluster type and distance to the nearest larger centre ('Nearest larger centre' is defined as the nearest town centre accessible by car whose combined population and number of jobs exceed those of the centre in question)

Overall, the cluster analysis shows that the historic town and village centres of Upper Austria do not present a homogeneous picture of development: while some function as vibrant places to work and live, others are struggling with structural decline and loss of function. Town and village centres with greater central importance seem to be less affected by negative trends. In any case, the results make it clear that future strategies for strengthening town and village centres must be differentiated and tailored to specific types.

6 Conclusion and Practical Implications

The present results illustrate that historic town and village centres in Upper Austria are undergoing profound structural and functional change. The delimitation method based on the *Franziszeischer Kataster* (Franciscan cadastre) has proven suitable for consistently recording historic settlement areas and decoupling them from functional attributions. The approach enables an analytically clean, spatially comparable investigation, which is supported by validation with current core zone delimitations. Nevertheless, the method is not free of uncertainties: differences in the timing of surveys, cartographic distortions and heterogeneous data qualities can cause local inaccuracies. For future applications, further development towards automated, learning-based methods is recommended in order to enable large-scale analyses with greater precision. The latest studies can be drawn upon here – such as the “RePaSE project” (GÖDERLE et al. 2024), in which a model for the automated detection of buildings from the *Franziszeischer Kataster* was developed.

In terms of content, the analyses reveal a clear tension between structural densification and functional emptying. Despite an increase in the number of buildings and dwellings in historic town and village centres, there has been no corresponding growth in population. Instead, the population has aged, households have become smaller and vacancy rates have risen. This “vacancy-new construction paradox” points to a misallocation between housing supply and actual demand. In many centres, the demographic doughnut effect has intensified, with more vibrant outskirts and increasingly sparse centres. The results thus underscore the need to mobilise vacant properties and unused land as a resource for sustainable inner-city development without endangering the historic building fabric.

When it comes to accessibility, the picture is mixed: historic town and village centres are usually within walking distance and easily accessible by bicycle within their communities, which offers considerable potential for climate-friendly mobility. At the same time, however, there is considerable room for improvement in some centres, particularly in terms of public transport connections. Around half of the centres surveyed do not have a stop in the immediate centre – a finding that weakens the attractiveness of these areas as everyday locations. This threatens a further decline in visitor frequency and the local supply function.

Overall, several recommendations for action can be derived from the results: Firstly, it is recommended that town and village centres be recorded in future on the basis of uniform, comprehensible demarcation criteria in order to enable comparability and targeted control

of measures. Secondly, measures to revitalise vacant properties and functionally reactivate retail locations are necessary, which go beyond purely construction policy approaches. Thirdly, local mobility and public transport connections need to be strengthened in order to ensure frequency and amenity value. Fourthly, the conscious handling of historical buildings as an identity-forming element is central to preserving the cultural value of town and village centres. Finally, a supra-regional, type-specific approach – at the Austrian or a broader level – could be established to identify good practice examples and promote a learning network of vibrant town and village centres. The latest developments in the vectorisation of the *Franziszischer Kataster* ('Franciscan cadastre') can be a valuable driving force in this regard.

In summary, it is clear that the historic town and village centres should not be viewed as static relics or intrinsically resilient centres. Rather, they are hybrid spaces between heritage and renewal, whose future viability depends crucially on the coherent interlocking of planning, social and economic strategies. Integrated, data-based and type-sensitive planning can help developing historic town and village centres as lively, multifunctional centres of architectural value in the future.

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