

## A CASE STUDY OF THE TERRITORIAL MERGING OF THE URBAN PLANS OF SELECTED MUNICIPALITIES TO A CONTINUOUS VECTOR MAP

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**Abstract.** This article is about the territorial analytical documents used in the Czech Republic and about the process of forming urban plans from the perspective of a geoinformatic and cartographer. Geoinformatical attitude is focused on the problems associated with the conversion of existing analogue urban plans and urban plans in the CAD format into the unified ESRI shapefile format (\*.shp). The article deals with a couple of the single steps of the process, from data model forming and deciding the parameters of the layers by digitizing urban plans in analogue format, to generalization and rectification, to final editing to the continuous vector urban plan, and proceeds further with the linking of the urban plans of several municipalities, in this case Křelov-Břuchotín, Příkazy and Skrbeň. Some existing methodologies, which were used as a base for the work, are mentioned. In the second part, the cartographical view of this problem is described. The article shows how to link two different legends of various authors together. Then there is a solution for the distribution of the converted urban plan to the end user who is uninformed about software with limited capacity for cartographic expression. The necessary conditions for the software to be proper for both the end user and for the ESRI shapefile format (\*.shp) are also mentioned.

**Keywords:** case study, urban plan, continuous vector map, data model

### 1 Introduction

Nowadays, there is a trend in urban planning of converting urban plans from analogue form to digital form, or to form urban plans directly in digital form. Users can view urban plans in different map scales, they can visualize only the layers that they need, and they can print only the area that they want. Digital urban plans are portable on flash discs or CDs, which is simpler than in paper form.

## 2 Area of Interest

A continuous vector map will be used as informational material for mayors of municipalities. It will help with the project "Moravská cesta", whose aim is to build or repair bicycle paths in the area of several municipalities. Because of this, the three municipalities of Křelov-Břuchotín, Příkazy and Skrbeň were chosen for the work. The layer "navrh\_moravska\_stezka\_linie.shp" was included. It contains the approximate route of the bicycle paths.

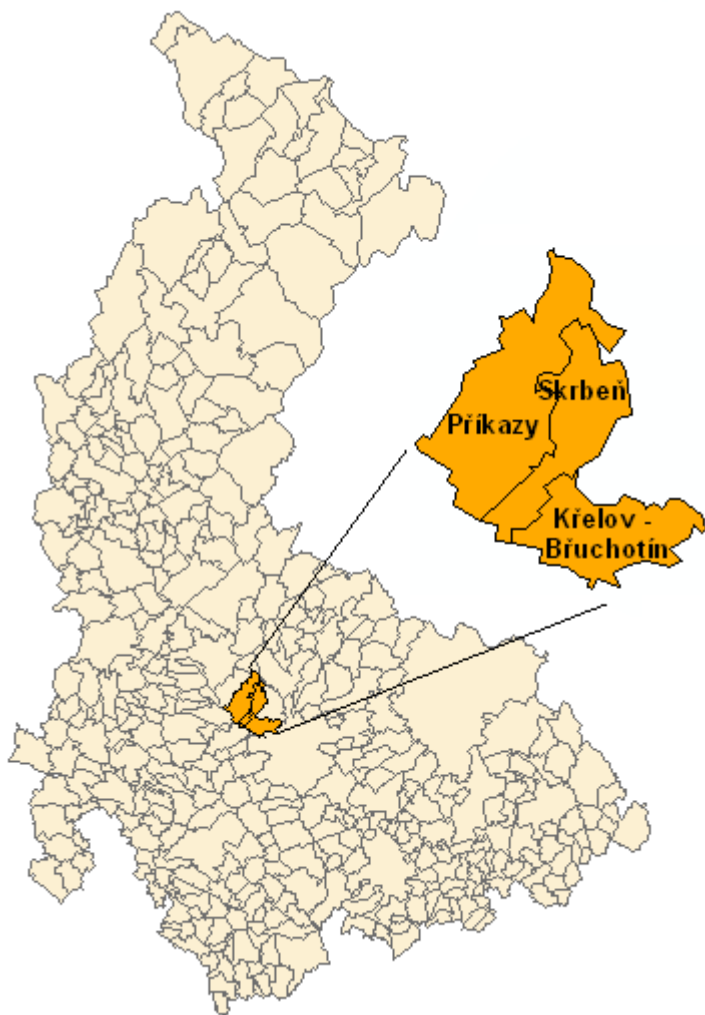


Fig. 1. Area of interest in scale 1: 1 000 000, cut in scale 1: 200 000

## 3 Input Data

The urban plans of the municipalities in the area of interest were used. These urban plans were lent to us by the mayors of these municipalities.

There were two municipalities, Příkazy and Skrbeň, with analogue urban plans only, and one municipality, Křelov-Břuchotín, with both analogue and digital (\*.dgn) plans.

**Table 1.** Fabricators of urban plans

Municipality	Fabricator	Address of fabricator	e-mail of fabricator	date of fabrication
Křelov-Břuchotín	Alfaprojekt Olomouc a.s.	Tylova 4, Olomouc 772 22	alfaprojekt@alfaprojekt.com	12/2005
Příkazy	Ateliér-r spol. s r. o.	Uhelná 27, Olomouc 772 00	atelier-r@atelier-r.cz	4/2001
Skrbeň	Ateliér-r spol. s r. o.	Uhelná 27, Olomouc 772 00	atelier-r@atelier-r.cz	12/1998

Because the fabricators are different, there are differences between the urban plans. There is a list of the urban plans in table 2.

**Table 2.** List of urban plans of municipalities

Křelov-Břuchotín	Příkazy	Skrbeň
1 Wider relations (Širší vztahy) 1:25 000	1a Comprehensive urban design (Komplexní urbanistický návrh) 1:2 500	1 Comprehensive urban design (Komplexní urbanistický návrh) 1:2 500
2 Main Drawing - functional recovery, regulation, land use limits (Hlavní výkres – funkční využití, regulace, limity využití území) 1:5 000	2a Main Drawing (Hlavní výkres) 1:5 000	2 Comprehensive urban design (Komplexní urbanistický návrh) 1:5 000
3 USES, landscape ecology, green (ÚSES, krajinná ekologie, zeleň) 1:5 000	3a Spatial Solutions (Prostorové řešení) 1:2 500	3 Spatial Solutions (Prostorové řešení) 1:2 500
4 Transportation (Doprava) 1:5 000	4a Transportation (Doprava) 1:2 500	4 Transportation (Doprava) 1:2 500
5 Water utilization (Vodní hospodářství) 1:5 000	5a Water utilization (Vodní hospodářství) 1:2 500	5 Water utilization (Vodní hospodářství) 1:2 500
6 Energy, Telecommunications (Energetika, telekomunikace) 1:5 000	6a Energy and Telecommunications (Energetika a spoje) 1:2 500	6 Energy (Energetika) 1:2 500
7a Agricultural part - conquest ZPF (Zemědělská část – zábor ZPF) 1:5 000	7 Wider relations (Širší vztahy) 1:25 000	7 Evaluation of conquest ZPF (Vyhodnocení záboru ZPF) 1:5 000
7b Agricultural part - conquest ZPF (Zemědělská část – zábor ZPF) 1:2 000	8a Evaluation of conquest ZPF (Vyhodnocení záboru ZPF) 1:5 000	8 Wider relations (Širší vztahy) 1:25 000
8a Public utility constructions (Veřejně prospěšné stavby) 1:5 000	8b Evaluation of conquest ZPF (Vyhodnocení záboru ZPF) 1:5 000	9 Public utility constructions (Veřejně prospěšné stavby) 1:2 500
8b Public utility constructions (Veřejně prospěšné stavby) 1:2 000	9a Public utility constructions (Veřejně prospěšné stavby) 1:2 500	

## 4 Plan of Work

The goal of this article was to find the best way to merge the urban plans of the chosen municipalities, which have differing quality and formats, for further usage by the representatives of these municipalities. To reach this goal we had to test different paths (Fig. 2).



Fig. 2. Different designed ways to merge urban plans

The processes that we designed were studied and tested. The third path, which is in the middle, was chosen as the best, and was visualized.

#### 4.1 Getting to Know the Area of Interest

For this purpose, a list of the map items contained in the urban plans of the municipalities was made. This list was later used for the generalization and intersection of the map keys.

#### 4.2 Scanning

A large-scale scanner, the COUGARTx36, was used for scanning. Scans were provided in resolution of 300 dpi. The scans were named "name of the municipality\_number of map\_name of map\_map scale" (for example: krelov\_2\_hlavni\_vykres\_funkcni\_vyuziti\_regulace\_limity\_vyuz\_uz\_1\_5000.tif) for better lucidity.

#### 4.3 Generalization and Map Keys Intersection

Because of disunity in the urban plans of the municipalities, we had to generalize and then make a map keys intersection. This was due to the differences in the fabrication, authors, and map scale.

Generalization was made using the map that contained the lowest extent of information of all the urban plans with the same topic, with effort to keep the biggest size of information (for example for layer transportation (doprava) it was Skrbeň). Generalization was also influenced by terrain examination and knowledge in the area of interest.

After generalization the map keys intersection followed.

#### 4.4 Data Model

Before forming the data model, the following methodologies were studied (references are in chapter References). They were used as a template for the work:

- MINIS: The minimum standard for digital processing urban plans of municipalities in GIS in the Pardubice Region (MINIS: Minimální standard pro digitální zpracování ÚP měst a obcí v GIS v Pardubickém kraji),
- Study ("Draft Standards for territorial planning documentation for GISovské applications - Methodology"): Annex A.7.1. Data model (Studie („Návrh standardů územně plánovací dokumentace pro GISovské aplikace – metodika“): příloha A.7.1. Datový model),
- Single procedure of digital processing urban plan for GIS: Processor manual (Jednotný postup digitálního zpracování územního plánu obce pro GIS: Příručka pro zpracovatele),
- Methodology for digital processing UPN of municipality for GIS of District Office: version 1.5 (Metodika digitálního zpracování UPN obce pro GIS okresního úřadu : verze 1.5),
- Annex 1 to Decree No. 500/2006 Coll. the territorial analytical documents, planning documents and records how urban planning activities (příloha č. 1 k vyhlášce č. 500/2006 Sb. o územně analytických podkladech, plánovací dokumentaci a způsobu evidence územně plánovací činnosti).

After the literature was studied, the data model was made. We took into account the profile of future user, who will be representatives of municipalities, i.e. untrained in GIS. Because of this, the most simple data model possible, with a logical order of layers was made.

Map items were divided into layers. They were named "name of municipality\_name of layer\_data type" (bod as point layer, linie as line layer and pgn as polygon layer) for example krelov\_silnicni\_doprava\_pgn.shp. Layers are divided into logical groups (for example transportation or habitation).

After the layers of the municipalities were linked into one, it was named "name of layer\_data type" (bod as point layer, linie as line layer and pgn as polygon layer) for example, silnicni\_doprava\_pgn.shp. The attribute table of every layer contains the columns "class (kategorie)" and "municipality (obec)" and in some cases "note (poznámka)" (Table 3).

**Table 3.** List of urban plans of municipalities

Field Name	Data Type	Length
class (kategorie)	text	25
municipality (obec)	text	20
note (poznámka)	text	50 or 100

Because this is not an official document, other columns were not added, because for example columns such as "area" or "length" would lead to decision-making based on data in an attribute table, in place of an official document as for example a cadastral map.

The ESRI shapefile format was chosen with a view to facilitate the usage of data layers (analysis, data presentation, integration to a map server, self activate CD, easy portability and compatibility) [1].

#### **4.5 Vectorization of Analogue Data**

Data were vectorized using the urban plans of the municipalities and the program ArcGIS 9.2 by ESRI with a view towards generalization. There were three possibilities: automatic, semi-automatic and manual. The semi-automatic and manual were used.

Manual vectorization was used on-screen using the "Editor" and "Snapping" tools. A second possibility was semi-automatic vectorization, which used the tool "ArcScan". This tool was eliminated as unfit for this data type, with its content and variety of colour, because it only allows the vectorization of urban plans converted into monochromatic (black and white) form. ([3] adapted according to Létal, 2005).

#### **4.6 Data Conversion from CAD Format into ESRI Shapefile Format**

Data conversion from CAD format into ESRI shapefile format was achieved using the program ArcGIS 9.2 by ESRI using the command "Export data". The result was checked and corrected.

#### **4.7 Adjustment**

Two different methods of adjustment were used. In the first case, the vectorization was made first and then adjusted using the tool "Spatial Adjustment". This way was not suitable because the data were divided into the directories. In the second case, the procedure was inverse. First, the raster maps were adjusted using the tool "Georeferencing" and the cadastral map was then adjusted. The second way was better.

#### **4.8 Layers Merging**

The merging of different layers was achieved using two ways, depending on stage of work. In the first case, the merging was done after the vectorization of the analogue urban plans and the conversion of the plans from CAD format to ESRI shapefile format using the "Merge" command.

In the second case, the merging was done using scanned raster urban plans. Vectorization was done after merging the raster in the program Adobe Photoshop CS. This way was bad because the final file was too big and work with it was difficult.

#### **4.9 Map Key Forming**

For this work, the bachelor's thesis "Map key evaluation and proposition of urban plans of Microregion Hranicko (Hodnocení a návrh znakového klíče územních plánů mikroregionu Hranicko)" was partly used. Because of some useless cartographic marks and different conditions for map key forming in the programs ESRI ArcGIS 9.2 and Christine-GIS Viewer 1.3, the map key from that work had to be modified. Established cartographic marks were used (e.g. accommodation is red, sport is yellow).

The map key was made for and in the program Christine-GIS Viewer 1.3 and because of this, some cartographic marks had to be simplified.

**Table 4.** Example of part of the generalization, map key merging and cartographic marks

adresář (Feature Dataset)	shapefile (Feature Class)	typ	atribut - kategorie (sledovaného jevu)	Skrbeň	Křelov - Břuchotín	Příkazy	Generalizace	Legenda - Kristýna-GIS prohlížečka 1.3
doprava	silnicni_doprava_linie	linie	dálnice, rychlostní silnice, silnice I třídy, silnice II třídy, silnice III třídy, místní a účelové komunikace	Chodníky návrh		Chodníky návrh	Chodníky návrh	
				Chodníky stav		Chodníky stav	Chodníky stav	RGB: 194 84 0, typ: čárkovaná, velikost: 1
				Místní komunikace	Místní komunikace, uliční prostory návrh	Místní komunikace návrh		
				Místní komunikace návrh	Místní komunikace, uliční prostory stav	Nevyřazená místní komunikace	Místní komunikace návrh	RGB: 194 84 0, typ: plná, velikost: 2
				Místní komunikace stav		Místní komunikace stav	Místní komunikace stav	
								RGB: 163 255 115, typ: plná, velikost: 3
				Polní cesty/travnaté cesty návrh			Polní cesty/travnaté cesty návrh	RGB: 163 255 115, typ: čárkovaná, velikost: 1
				Polní cesty/travnaté cesty stav			Polní cesty/travnaté cesty stav	
								RGB: 0 128 64, typ: plná, velikost: 3
				Rychlostní silnice návrh			Rychlostní komunikace návrh	
				Rychlostní silnice stav			Rychlostní komunikace stav	trojitá čára RGB: 255 0 0, typ: plná, velikost: 2, výplň: RGB 255 255 255
								
								trojitá čára RGB: 255 0 0, typ: plná, velikost: 4, výplň: RGB 255 255 255
				Rozhledové pole křižovatk		Rozhledové pole křižovatk		
				Silnice I. třídy stav	Silnice a místní komunikace ke zrušení	Silnice I. třídy stav	Silnice a místní komunikace ke zrušení	tečkovaná RGB 221 198 34, typ: plná, velikost: 1
								
								dvouřádková čára RGB: 255 0 0, typ: plná, velikost: 3, výplň: RGB 255 255 255
				Silnice II. třídy stav	Silnice II. třídy návrh	Silnice II. třídy stav	Silnice II. třídy návrh	
								trojitá čára RGB: 255 0 0, typ: plná, velikost: 3, výplň: RGB 255 255 255
				Silnice III. třídy návrh	Silnice III. třídy návrh	Silnice III. třídy návrh	Silnice III. třídy návrh	
								dvouřádková čára RGB: 255 0 0, typ: plná, velikost: 3, výplň: RGB 255 255 255
				Silnice III. třídy stav	Silnice III. třídy stav	Silnice III. třídy stav	Silnice III. třídy stav	
								trojitá čára RGB: 225 170 0, typ: plná, velikost: 3, výplň: RGB 255 255 255
				Silnice III. třídy/místní komunikace návrh				
				Silnice III. třídy/místní komunikace stav				dvouřádková čára RGB: 225 170 0, typ: plná, velikost: 3, výplň: RGB 255 255 255
				Účelové cesty návrh		Účelové cesty návrh	Účelové komunikace návrh	
				Účelové cesty stav		Účelové cesty stav	Účelové komunikace stav	čárkovaná RGB 168 112 0, typ: plná, velikost: 1
								
								RGB 168 112 0, typ: plná, velikost: 3

#### 4.10 Distribution to the End User

There are several solutions for urban plans as a web application, for example T-MapServer [6]. Our aim was to test desktop solution.

The product is designed for a small municipality, so the requirements for presentation software were: freeware, possibility to set relative paths, easy controlling and Czech language, so Janitor 2.4.7 and his part JanMap was chosen. But this version of the program contained mistakes, which prevented us from using it (5<sup>th</sup> May 2009).

Another possibility was ArcExplorer by ESRI. But this was not the best of the software tested, so finally Christine-GIS Viewer 1.3 was chosen. Christine-GIS Viewer 1.3 is freeware and has the possibility of setting relative paths, easy controlling, and is in the Czech language.

A self-activating CD with a user manual and projects Studied Area (Studované území) (projekt.cri), Příkazy-Hynkov (prikazy.cri), Skrbeň (skrben.cri) and Křelov-Břuchotín (krelov.cri) was made in the program Autorun.



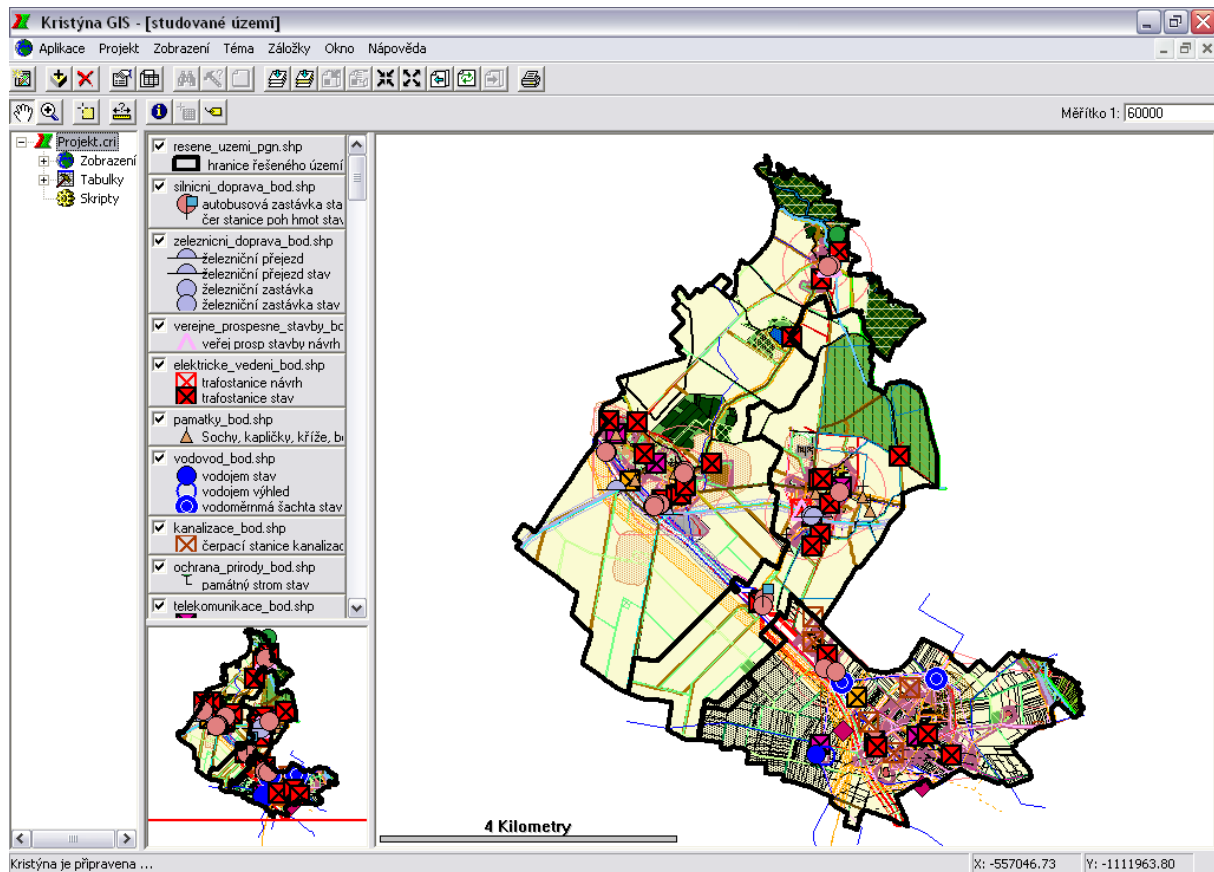


Fig. 3. Example of part of the final product

## 5 The Legal Context of Urban Planning

There are several laws and decrees dealing with urban planning in the Czech Republic. Table 5 lists a few of them.

**Table 5.** Example of laws and decrees dealing with urban planning in the Czech Republic (edited according [7])

Laws and decrees dealing with urban planning in the Czech Republic in English	Laws and decrees dealing with urban planning in the Czech Republic in Czech
Act No. 183/2006 Coll., on Town and Country Planning and Building Regulations	Zákon č. 183/2006 Sb., o územním plánování a stavebním řádu
Decree No. 500/2006 Coll., on planning analytical materials, planning documentation and way of planning activities filing	Vyhláška 500/2006 Sb., o územních analytických podkladech, územní plánovací dokumentaci a způsobu evidence územně plánovací činnosti
Decree No. 501/2006 Coll., on general territorial management requirements	Vyhláška č. 501/2006 Sb., o obecných požadavcích využívání území
Decree No. 503/2006 Coll., on detailed arrangement of planning permission proceedings, contract governed by public law and of planning provision	Vyhláška č. 503/2006 Sb., o podrobnější úpravě územního řízení veřejnoprávní smlouvy a územního opatření

## 6 Summary

The goal of this work was to bring urban plans in a digital form to current users, in this case the mayors of municipalities, and to enable them to work with these plans. There were five possible methods of how to achieve this. All of the possibilities were examined and the best of them was chosen. Then it was visualized using the methods mentioned in the article.

More information about this work is available on the website of the department of Geoinformatics of Palacky University in Olomouc at [www.geoinformatics.upol.cz](http://www.geoinformatics.upol.cz), in the diploma thesis section or on the website of Christine-GIS at <http://www.christine-gis.com/cz> in the articles section.

*This contribution was supported by project GA CR 205/09/1159 - "Intelligent System for supporting interactive thematic maps" ("Inteligentní systém pro interaktivní podporu tvorby tematických map").*

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**Methodologies**

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