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WORKING AT TDS TELECOM THIS SUMMER: CAD TO GIS TRANSFORM AND CREATING ARCGIS TOOLS BY USING PYTHON SCRIPTS

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WORKING AT TDS TELECOM THIS SUMMER: CAD TO GIS
TRANSFORM AND CREATING ARCGIS TOOLS BY USING PYTHON
SCRIPTS

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MAY 2016

A MASTER'S PROJECT

Submitted to the faculty of Clark University, Worcester,
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Community, and Environment

And accepted on the recommendation of

Yelena Ogneva-Himmelberger, Chief Instructor

ABSTRACT

CAD TO GIS TRANSFORM AND CREATING ARCGIS TOOLS BY USING PYTHON SCRIPTS

Zhen Yuan

My summer internship at TDS telecom last for 3 months from June to August of 2015, where I learned many academic skills and techniques during this process. Except these skills I also learned a lot from this traveling to Wisconsin itself. TDS telecom is an American local telecommunication company which is headquartered in Madison, Wisconsin. And this internship was a paid full-time internship which can be separated into two parts: manually transferring CAD data and creating python scripts to transfer the CAD data.

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Finally, I would like to thank all of my classmates for a lot of helps with both academic and life.

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INTRODUCTION

2015 summer internship is a requirement for all of us internship-track students. We searched internship opportunity online since this March. Both emails from school and some job hunting websites like “Indeed” can provide us the possible internship chances. For me, I spent most of my time applying internship on indeed and finally got an internship from TDS which located in Madison, Wisconsin. This was a payed full time internship which began on 1st June. And I spent almost 3 months there both learned work skills and experienced a period which may be similar as my oncoming life.

CHAPTER 1: DESCRIPTION OF THE TDS

1.1 History and Background

Telephone and Data Systems, Inc. (TDS) was established in 1969 as a combination of 10 small, rural telephone companies, and now is a Fortune 1000® company with six million customers nationwide. TDS Telecom, and U.S. Cellular are two subsidiaries which are wholly owned by Telephone and Data Systems Inc.

TDS Telecom, the company where I did my summer internship, is an American local telecommunication company which is headquartered in Madison, Wisconsin. It offers telephone, broadband Internet and television services to customers in more than a hundred rural, suburban, and metropolitan communities. It also sells businesses communications services including VoIP (managed IP hosted) phone service, dedicated

broadband Internet and hosted-managed services. With headquarters in Madison, TDS Telecom operates OneNeck IT Solutions, TDS Baja Broadband LLC, and BendBroadband. The company employs nearly 3,300 people in total. The milestones below describe significant events in the company's history (Excerpts from the company website):

1969: LeRoy T. Carlson founds the company with 10 small, rural telephone operations in Wisconsin.

1970: LeRoy Carlson, foreseeing the critical role of data, renames the company Telephone and Data Systems, Inc.

1976: TDS purchases its first electronic switching systems, expanding from a traditional telephone service provider to a telecommunications company.

1997: TDS Telecom begins offering DISH Network™ satellite TV service.

2000: TDS Telecom introduces digital subscriber line (DSL) service.

2004: TDS Telecom's DSL market share in its ILEC markets surpasses that of cable modem after only four years of offering DSL.

2008: TDS list on the New York Stock Exchange, retaining their ticker symbols. TDS Telecom introduces managedIP, a hosted Internet Protocol (IP) solution for businesses, and launches TDS TV® in two trial markets in Tennessee. TDS founder LeRoy T. Carlson becomes director emeritus of TDS, a non-voting position.

2011: TDS Telecom are named J.D. Power and Associates 2011 Customer Service Champions. TDS acquires Arizona-based OneNeck IT Services Corporation, a provider

of hosted application management and managed IT hosting services. OneNeck is managed by TDS Hosted & Managed Services, LLC.

2012: TDS, parent company to TDS Telecom, acquires Vital Support Systems, LLC. This acquisition brings deep IT Solution Provider capabilities to TDS Hosted & Managed Services, LLC. TDS Telecom's proprietary IPTV service, is available in 10 markets by the end of 2012. U.S. Cellular brings 4G LTE network access to 61 percent of its customers, and introduces iconic new 4G LTE smartphones, tablets and mobile hotspots.

1.2 Mission and Main Work

TDS telecom provides various telecommunications services and products to consumers and businesses across the United States. To sum up, there are three main works in TDS telecom:

The first one is phone services. Like many other telecom companies, TDS offers phone service for residential customers. There are different package options which can be chose by customers. Though TDS phone, users can not only enjoy the affordable local and international calling, but they can also utilize many additional phone service like anonymous call rejection, voicemail and 3-way calling conversation.

The second main work of TDS telecom is broadband internet. TDS offers a wide range of internet speed to fit every lifestyle and budget, which also includes the nation's fast home internet – 1Gig with up to 1Gbps download. TDS internet service also includes

very complete internet security tools which can lower customers' risk of exposure to viruses, spywares and Spams.

The last main work in TDS telecom is TV services. TV services in TDS is powered by IPTV (Internet Protocol Television), users can watch more than 190 channels with more than 100 HD channels. However, TDS TV is only accessible in 7 states.

1.3 Organization Structure

Dave Wittwer is currently the president and chief executive officer of TDS Telecom. He has been with TDS for more than 30 years. During this time, he has held many leadership positions including: executive vice president of Staff Operations, chief financial officer, president of the company's ILEC operations, and chief operating officer. These experience has served as preparation for his current role as president and CEO, to which he was appointed in 2006.

The TDS Telecom include mainly 7 departments: finance, government & regulatory affairs, information technologies, marketing, sales & customer operations, network operations, network service and oneneck it solutions department. The company employs nearly 3,300 people, who work in different departments. The number of people that each team contained is varied. For our GIS team, there are nearly 20 people in it.



Figure 1 Structure of TDS Telecom

1.4 GIS section

For quite a long time, our spatial researches are based on the CAD database, which has limited capabilities for analytics and may not be 100 percent spatially accurate. As a result, recently our GIS team is working on transferring data from CAD system to GIS database. We also develop scripts to create both ArcGIS tools to advance this progress

and web maps to display geographic data of the company. There are 15 members who came from all over the county in our GIS team.

To sum up, in the internship period, our GIS team mainly worked on the following parts:

- Develop scripts that will automate of tasks within the GIS software and TDS data model.
- Develop dashboards that will be used for non-GIS personal to query data.
- Normalize files with TDS standard map scales levels, symbology, parcel data sets.
- Analyze and correlate data from a variety of sources to be linked to features.
- Develop databases for managing a verity of project data and data entry in to the database.
- CAD to GIS data migrations.
- Web mapping for geographic data of the company.

CHAPTER 2: INTERNSHIP RESPONSIBILITIES

2.1 Overview

Our GIS team is mainly working on creating the new database of cables and other accessory equipment during the summer time. This database is the foundation of further analysis. We were given many CAD maps of different states from our subordinate companies, and need to transfer them to CAD database. During this progress, we also need to correct the mistakes in the CAD map based on our judgment and google earth. There are two prime parts in my summer time: Transfer the database manually and writing python scripts to create ArcGIS tools to accelerate the transformation efficiency.

2.2 Manually Transferring CAD data

The database we need to transfer is quite a big system. More than 10 states data which are consisted of thousands of CAD maps wait to be transformed. Before I been to Madison to join the team, other teammates have already worked on this project for a long time (more than one year). This working experience form a complete workflow in our team. Ideas from different memberships combined together and finally created a guidance book.

Based on this book and other teammates help, I began my first exchange. One exchange area is consisted of several CAD maps. As a result, we first need to combine these maps together. Mosaic module in AutoCAD can finish this job. Most CAD maps have a

reference which can be used to aggregate together. However, some CAD maps may lost this reference and we can select and move them manually to finish combination process. After that I need to import CAD map into ArcMap, the CAD map is not accurate in most case, as a result we first need to run georeferencing and spatial adjustment tool to adjust the imported CAD map based on an accurate referential shape file. Different categories have to be separate based on the information stored in the attribute table. These information are created with the CAD map. However, we don't have the category's name for each group. What we have is only the facility name for different features. Different feature classes have different rules for naming. For example, fiber cable may contain a "CO" in their facility name and copper cable may have a "CF" in it. The whole naming rule is very complicated, we have a 3 pages document for this rule. As a result, it always takes some time for us to classify the map into different categories. After the classify process, we also need to do some further spatial adjustments. Since our data is composed of many cable data and a cable always lies along the street side, we need to adjust the cables based on the google map and assign them to be along the street side. We also need to combine the segments of some cables and polyline feature classes in this step. The same thing waits to be done for point feature classes, we need to assign them to correct position based on reference maps. After the whole process we will utilize the ArcCatalog to write metadata for these feature classes and import these data into company's database.

The manually transferring process takes some time for each map. That's why I came up with the idea that we can use the python script to accelerate this process.

2.3 Developing ArcGIS tool for the transferring process

During the summer time, I have created several ArcGIS tools for my company to advance efficiency of the transferring process. Knowledge absorbed from the python course helps me a lot. Before developing these ArcGIS tools it always takes me a long time to go through the whole transform process. The classification step, for example, I always need to spend around 2 hours to clearly classify different features into different categories. Since I take python class before, I believe I can create an ArcGIS tool for our company to automatically classify the features. As a result, I talked with my supervisor with this idea and he finally accepted my idea and assigned me a new project --- to create ArcGIS tool for classification. He also assigned me a skilled teammate who I can turn to when I have problems with the classification rules. It takes us around 2 weeks to create this tool and it works pretty well. It basically looks into the attribute tables to identify different categories based on the information stored in it. After creating this tool I also create some other tools to automate some manual works. Figure 2 and Figure 3 below show some ArcGIS tools I created in the internship.

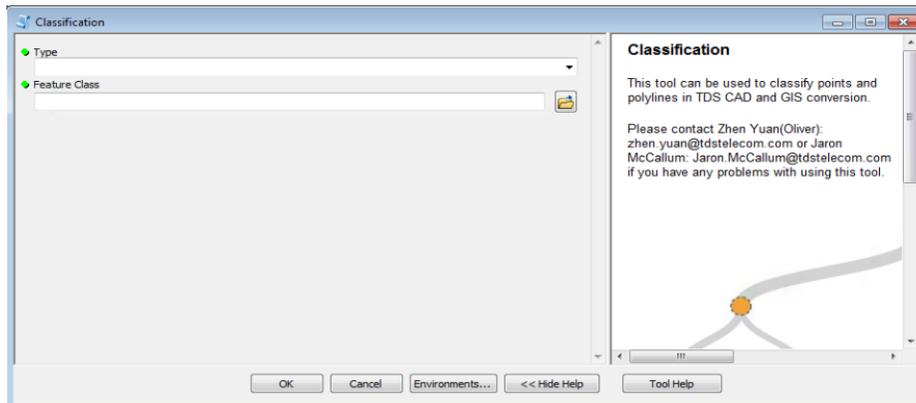


Figure 2 Classification tool I created during the internship

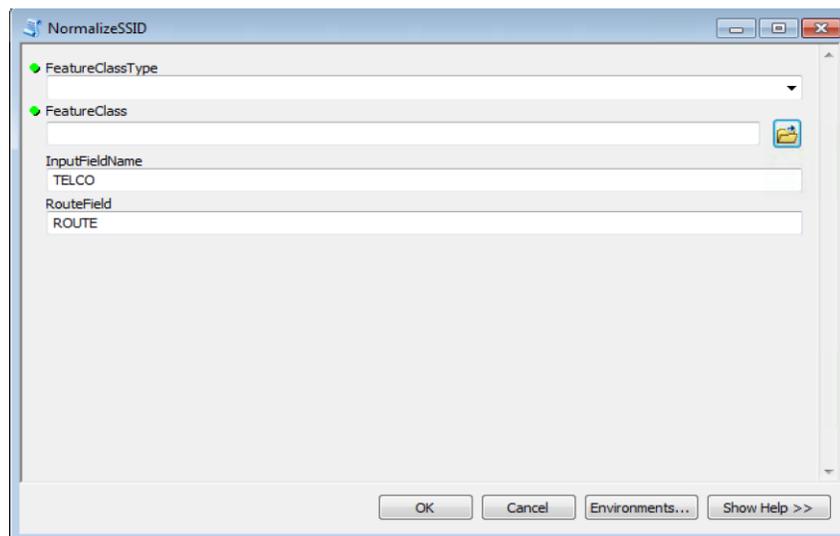


Figure 3 Normalize tool I created during the internship

CHAPTER 3: INTERNSHIP ASSESSMENT

3.1 Overview

This internship is a very meaningful experience for me. It not only gave me the opportunity to learned more techniques and knowledge of my major and also provided me an experience to work in a U.S company. During this summer, I studied some new skills and tools like using AutoCAD which I didn't obtain from the school and also learn to apply my knowledge acquired from school to my practical work. Different ideas from everyone are accepted by the team. Also the working environment here is pretty good, everyone have their own separate room to work and supervisor also occasionally bought some food and T-shirt or jacket for us. Every Monday our team will have a meeting to discuss the progress, new finding and feature works. Also, since all of my teammates are Americans, I have to talk in English and learn America culture every day. It's hurt for me at the first time because I spent most of my time with my Chinese friends and we speak Chinese every day. However, since I always need to ask or explain questions with my teammate during this internship, it's better for me to think and talk with English after this summer.

3.2 GIS skills learned from the internship

Some GIS skills are learned from this internship. Working with ArcGIS for almost 2 months helped me to be more familiar with this software. During this summer I touched with some tools like spatial join and snap which I didn't know them before. Also continuously utilizing

some tools which I already know gave a more complete understanding of them. Some of these understanding may be very simple but easy to ignore. For example, when using an editor tool, I previously just know that we can edit the selected files, however, we can also choose a folder in the editor tool and every files in this folder can be edited at the same time. Also, this internship helped me to learn more about the python programming. When it comes to works there are always many practical problems which we may not face in the classroom. As a result, I have to learn more about the programming on my own, which provide me a more deeply understanding of the python and give me many hands-on programming experience.

3.3 Other Lessons learned from this internship

This summer internship more like a lesson for me where I learned a lot except some academic skills. First of all, it is important to present your own ideas in the work. A company always have its workflow that everyone just need to follow the steps to finish our work. However, some steps may be accelerated using our own method. As a result, it's a critical skill to know which part of our own knowledge can be used into our practical works. Secondly, even though it's important to deeply learn into some area and some skills, it's also significant to have a wide range of knowledge. We will never know which part may be useful in our work, and have a wide range of knowledge can always provide us a new view or idea for what we are doing. Also discuss your idea with your teammates is also import, during this process we can share our opinions, complete this idea and easier to find flaws in the idea.

3.4 Working environment and teammates

Working environment and our teammates here is satisfactory. Everyone have a separate room for work and there are many restaurants we can choose just outside the working building. Time arrangement is reasonable every Monday we will have a meeting to summarize what we have done, our ideas and feature works and every Thursday our teammate will have a happy hour to relax ourselves. Every day, after we worked 8 hours we can decide whether we want to leave or stay to work more. And we will get a 150% salary for these extra working time. Our teammates are patient, even though I am not very good at speaking or thinking in English they still willing to explain questions for me until I totally understand. Figure 4 below shows my working environment.

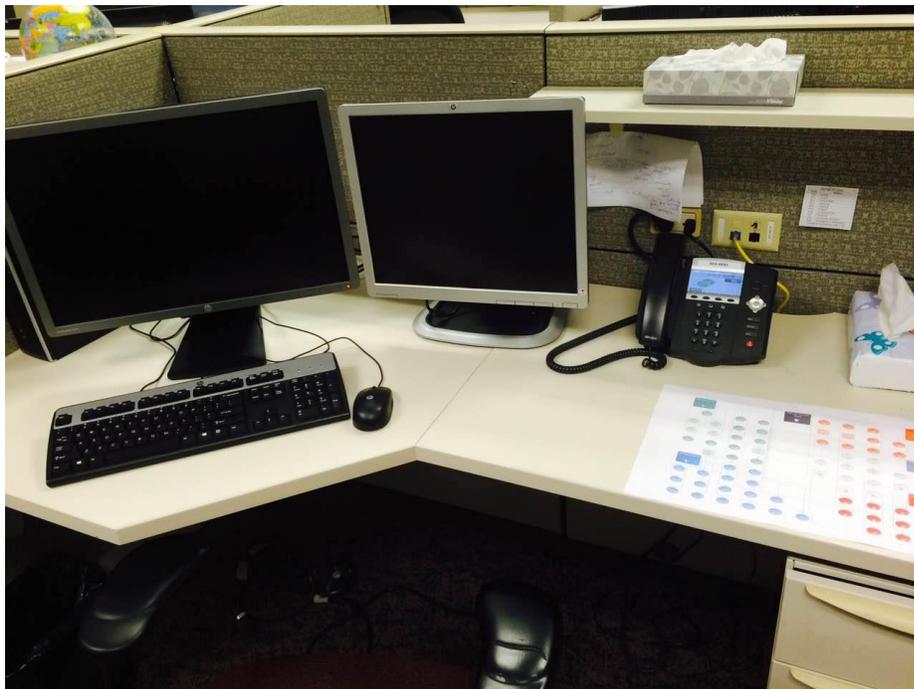


Figure 4 Work environment

CHAPTER 4: CONCLUSION

Working in TDS this summer was a great experience for me. Skills and academic knowledge learned from it not only made my study for feature courses easier but also prepared me well for the next semester's job hunting. Also, experience of working with many talented teammates also brought me new views and ideas for our GIS works. Even traveling outside the state to Wisconsin and staying there itself, provided me many experience for feature oncoming life in U.S.

GLOSSARY

GIS – Geographic Information Science

GISDE – GIS for Development and the Environment program in the IDCE

TDS – Telephone and Data Systems

LLC – Limited Liability Company

IPTV – Internet Protocol Television

DSL – Digital Subscriber Line

ILEC – Incumbent Local Exchange Carrier