RITA Research and Innovative Technology Administration

Highway Transportation Engineering

ITS Case Study

Component 2 – Student Guide

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Introduction and Overview

This component is a compilation of documents, emails, meeting notes, IM conversations, websites, and resource material that describe the events of an Adaptive Signal Control Technology project. You are an important member of the team, and as you read through these materials, you should put yourself in the shoes of the Junior Engineer.

Component 2 Terminal Learning Objective:

- Analyze data from a qualitative perspective to substantiate the selection of adaptive signal control as the solution

Component 2 Enabling Learning Objectives:

- ELO 1: Define your role and responsibilities on an ITS project
- ELO 2: Identify traffic patterns and existing signal architecture
- ELO 3: Relate operational strategies to constituent interests, agency goals and objectives
- ELO 4: Compare and contrast adaptive and non-adaptive technology systems

Directions

This component is divided into four tasks. Read through each task and answer the Critical Thinking Questions at the end of the task as directed by your professor. Bring your answers with you to the next class and be prepared to discuss your findings.

As you read through this component, you will notice that there is some text highlighted and in italics. This text is meant to provide context for this component and help you walk through each event.

Case Study – Task 1: Defining You Role and Responsibilities on an ITS Project

Today is your second day as an Entry-Level Engineer for the City of Hamilton Traffic/Transportation Planning Department (TTDP). The first day was a blur of introductions, a tour of the office, and a few meetings. You have a relatively new laptop and a bookshelf in your office to put all of those textbooks left over from college. You spent some time setting up your email, your computer, getting your IM working, and figuring out the printer.

Your boss, Mark, the senior engineer at Hamilton TTPD seems great. He's been where you are, and wants to bring you up to speed on the projects going on so that you can really get your feet wet. You are going to learn a lot working with him.

Your first project is to help prepare for a presentation to the National Avenue Traffic Coalition Committee to appeal for support on an innovative project – implementing Adaptive Signal Control Technology (ASCT) to improve Hamilton's transportation and traffic situation. The project is in its initial stages and preliminary data has been gathered to support the need for a solution to the current traffic issues. Mark scheduled a meeting with the team this morning at 9 a.m. in the Lake Superior Conference Room to explain what has been on the project to date and get you up to speed.

You have a few minutes before the meeting, so take a look at the description of your job and the department to get a sense of your role on this technical team.

JOB DESCRIPTION

AGENCY/COMPANY TITLE:

City of Hamilton Traffic/Transportation Planning Department (TTPD)

JOB TITLE:

Transportation Civil Engineer/Entry-Level

JOB DESCRIPTION

The City of Hamilton Traffic/Transportation Planning Department (TTPD) is seeking an energetic, highly motivated, detail-oriented, self-starter. The department is responsible for overseeing the city's transportation infrastructure, encouraging public involvement, as well as traffic and ITS design and construction services. We offer more than just a job; we offer an opportunity to shape the world for generations to come through innovative and sound design.

JOB RESPONSIBILITIES

Under the supervision of a Senior Transportation Engineer responsibilities include:

- Assisting in the preparation of feasibility studies, environmental studies, traffic forecasts, traffic capacity and operations analysis, traffic signal design, signal timing, ITS planning and design, highway signing, and other related engineering and planning work.
- Assisting in the planning, design, and production of engineering drawings.
- Conducting engineering investigations such as collection and analysis of data using established procedures, performance of routine calculations, and participation in evaluating the feasibility of alternate solutions.
- Performing data acquisition and analysis, researching the feasibility of alternative design approaches, site conditions, and/or regulatory agency specifications or regulations.
- Preparing material for reports and permit applications, gathering information, writing rough outline, and/or preparing work progression documents and graphic presentations.
- Performs field observations of construction where appropriate.
- Participating in traffic data collection studies and conduct project-related field work.

EDUCATION/EXPERIENCE

B.S. in Civil Engineering in a branch of Civil Engineering directly related to hiring discipline (Transportation)

Special Skills: Good interpersonal skills and capable of developing technical writing, and communications skills. AutoCAD skills preferred and Microstation a plus!

Professional Registrations: E.I. or EIT desired.

Preferred Qualifications: Internship or co-op experience
Familiarity with ArcGIS, HCS, Synchro, and VISSIM

The City of Hamilton Traffic/Transportation Planning Department (TTPD)

The Traffic/Transportation Planning Department (TTPD) is responsible for overseeing the transportation infrastructure that spans the city's 19 square miles and 285 lane miles of streets.

There are two traffic engineers, you and your supervisor Mark Reynolds, Sr. Traffic Engineer, who are responsible for street operations and planning. The engineers are specifically responsible for collecting land use data, designing intersection geometry, and performing data analysis to determine traffic conditions.

Leslie Gonzales and Eric Martin are the Traffic Technicians in the office. They primarily work primarily out in the field, and are responsible for maintaining the system. Leslie and Eric deal with electrical components, enter timing parameters that were designed by the engineers, deal with vehicle detection and communication, and are responsible for installation, operation, and maintenance of 150 signalized intersections, 10 Driver Feedback Signs and 21 Pedestrian Warning Lights.

The Department is located in the eastern part of the city, approximately 10 miles from the focus of the ASCT pilot project.

It is 9 o'clock – time for your team meeting. Proceed to the Lake Superior Conference Room and get ready to learn about what your team is thinking for the National Avenue ASCT project.

Meeting: **National Avenue Status Meeting**

Date: Tuesday, June 3, 20XX, 9a.m. – 10a.m.
Location: Lake Superior Conference Room

Note Taker: Leslie Gonzales, Traffic Technician

In Attendance: Mark Reynolds, Sr. Traffic Engineer
Leslie Gonzales, Traffic Technician
Junior Engineer, Junior Engineer

Agenda:
- Project Background
- Status Update
- Next Steps

1. Project Background

Mark welcomed our new engineer and explained how excited we are to have a new team member on board. We look forward to getting our new engineer up and running quickly on this project so that the Junior Engineer can help present and answer questions in an upcoming meeting – Mark will explain the meeting we are working towards.

First, some background on the project: Mark explained that we are in the preliminary stages of gathering information to support the need for an updated solution to Hamilton's traffic problems. National Ave (the segment of roadway under review) spans over 38 miles so it directly impacts Hamilton as well as a number of neighboring cities. Our department has taken the lead since the stretch of National Ave that runs through Hamilton has been most heavily impacted by the increased congestion and development in the area.

In the past few months, we've received several complaint letters from citizens, organizations, and businesses regarding traffic congestion and safety concerns on National Ave. Most of the complaints are related to symptoms of signal light problems. We've had concerns on this stretch of road since the population growth increase and influx of new businesses, and also the growth of the University. Because the signal lights were installed before there was so much traffic to accommodate, we are having a difficult time using the older technology to

accommodate our present and future traffic volume. It is not designed to handle the volume and variation of traffic.

Mark will send the information he has put together on the overview of the project and its scope to the team following this meeting.

Basically, the next step on this project is to meet with the National Avenue Traffic Coalition Committee which is part of the Metropolitan Planning Organization – MPO – in late June, a small group of 5 transportation engineers and 1 police officer from communities that neighbor Hamilton, to get the National Ave signal light project approved.

Mark explained that the purpose of meeting with the Coalition is to present the problem we have identified, as well as our findings and data in the problem area, and the proposed solution with an explanation of how the solution will improve the problem.

What we need to do: We will be developing a concise version of a Concept of Operations (CONOPS) for our meeting with the Coalition. The CONOPS will contain the details of the project and data to comprehensively show how the solution we have selected will address our operational challenges.

What happens after the meeting with the Coalition: Following the Coalition's support of the project, we will take it to the Greater Southeast Steering Committee, a group of transportation engineers and planners, police officers and other emergency response personnel, the mayor, and citizens representing the greater public interest. The Steering Committee reviews all of the proposed projects for the area, prioritizes them, and awards funding respectively.

When the Steering Committee approves and funds a project it gets included in the Transportation Improvement Program (TIP) for our region. Once we receive a go ahead from the Coalition we will develop a more robust CONOPS to seek funding from the TIP. The TIP obligates federal funds to state and local projects. In other words, the TIP is a record of all of the projects that the region wants to do and how much funding is set aside for that project, including where the funds come from.

Ideally this project would be supported with federal funds but we will talk more about that once we get approval of the Coalition.

2. Status Update

Mark reviewed the Overview and Project Scope sections he pulled together that will go in the Concept of Operations for the Coalition meeting. Essentially, the Overview paints a picture of the current situation.

Mark has also finished the Project Scope which outlines the specific thing we are looking at – in this case, the signal lights at 15 intersections along National Ave – and summarizes information about the signal light's performance and capabilities.

The Engineering Team will pull together the project data sheet for the problem area. It includes things like an overview of traffic characteristics, descriptions of how land is used, what traffic is like during peak periods including the morning rush, lunch, and the afternoon rush, and then also what traffic is like in the evenings and on weekends.

Based on our findings and extensive research into alternatives it was determined that ASCT was the most effective and efficient option for the long term goals of our region. ASCT enables the city to achieve its objective of managing congestion by allowing the traffic signal system to be more responsive to variability in demand that is difficult to account for with traditional signal timing methods. Improving the utilization of green light time will reduce travel time, delays, fuel consumption, vehicle emissions, and stops along the main arterial through the city.

3. Next Steps

- Review Overview and Project Scope – Engineering Team
- Draft Project Sheet – Engineering Team

After the meeting, you chat with your team members about some of the other things going on in the office. After lunch you check your email, and you've got an email from your boss – the email that he said he would send during that morning's team meeting.

from: Mark Reynolds <markreynolds@statedot.gov>

to: Junior Engineer <juniorengineer@statedot.gov>

date: Tuesday, June 3, 20XX at 2:33 PM

subject: National Ave docs to review

mailed-by: mxh1.email-od.gov

Glad you were at our meeting today to get a sense of the project. I've attached the Overview and Project Scope that we told you about during the meeting. You can review this information to help you get a better idea of what is going on. We'll meet next week to talk about the Project Data Sheet.

Let me know if you have questions.
Mark

Attachment: NationalAveOverview&Scope_MR.doc

After reading the email, you open up the attachment that Mark sent you, named NationalAveOverview&Scope_MR.doc. This is what you find in that document.

NationalAveOverview&Scope_MR.doc

Overview

The City of Hamilton is a historic town within Chester County. According to the 2010 Census it has a population of 149,518. The town is also the northwestern terminus of a private toll road that connects to an international airport. The City of Hamilton, like the rest of Chester County, has undergone considerable growth and development over the last 30 years, transforming from a small, rural town to a suburban bedroom town for commuters to the larger surrounding cities. Current growth in the town and its immediate area to the east concentrates along the toll road and Route 7 (known as National Ave in the City of Hamilton).

Newton University, a small private college with an enrollment of 12,100, is located in the heart of downtown Hamilton. Bon Air Medical Center, Hamilton Fire Department, and Captain's Arena are located within miles of the university as well as several large shopping centers, and Western Plaza and the Heritage Mall.

Over the last decade, the population in Hamilton has doubled in size. The population swell has brought with it increased traffic congestion, especially along National Ave.

Project Scope

Within the City of Hamilton traffic congestion was rated as the most important issue with safety and maintaining low tax rates rating second and third. As a result, the City of Hamilton assigned the Transportation/Traffic Planning Department (TPPD) to explore and evaluate alternatives to reduce congestion.

A majority of the existing signalized intersections in the region are controlled by outdated hardware approximately 10-15 years old, and signal timing plans are not consistent with traffic demands. The existing system cannot recognize the onset of peak periods, so the peak period coordination introduction times are set conservatively to ensure they cover the normal variation in duration and intensity of the peak. This means that the timing is often less efficient during the early and late parts of the peak periods.

The Department identified Adaptive Signal Control Technology (ASCT) as the most

effective strategy for meeting the demands of both the current and future situation. Based on this recommendation and the analysis of the system to determine where ASCT implementation would be the most effective, Hamilton is seeking to implement ASCT at 15 signalized intersections on and adjacent to a portion the main arterial road (National Ave) to achieve the maximum roadway capacity, improve operating efficiency, and avoid unnecessary roadway widening.

ASCT would enable the city to achieve its objective of reducing congestion by allowing the traffic signal system to be more responsive to variability in demand that is difficult to account for with traditional signal timing methods. Improving the utilization of green light time will reduce travel time, delays, fuel consumption, vehicle emissions, and stops along the main arterial through the city.

If this pilot project is successful there is potential for ASCT to be implemented in more intersections over time.

This completes Task 1. Complete the Critical Thinking Questions at the end of this document for Task 1. Then, continue with Task 2.

Case Study – Task 2: Traffic Patterns and Existing Signal Architecture

It is now Thursday morning – day 4 on the job. You run into Mark in the hall that morning and he mentions that he has gotten a decent amount of the Project Data Sheet for the National Ave project drafted, and that as soon as he gets back to his office, he'll send you what he has so far.

Handout: Project Data Sheet

from: Mark Reynolds <markreynolds@statedot.gov>

to: Junior Engineer <juniorengineer@statedot.gov>

date: Thurs, June 5, 20XX at 10:13 AM

subject: Project Data Sheet

mailed-by: mxh1.email-od.gov

Glad we had a chance to catch up this morning. It's great you are already feeling comfortable and getting to know everyone in the office. As I mentioned I'm sending the Project Data Sheet that I put together so far. Take a look at it and make sure you are very familiar the area we are covering in this project. Your understanding of this information is going to be an essential piece of our briefing with the Coalition.

Don't hesitate to stop by if you have any questions.
Mark

Attachment: Project Data Sheet_MR.doc

After reading the email, you open up the attachment that Mark sent you, named ProjectDataSheet_MR.doc. This is what you find in that document.

PROJECT DATA SHEET

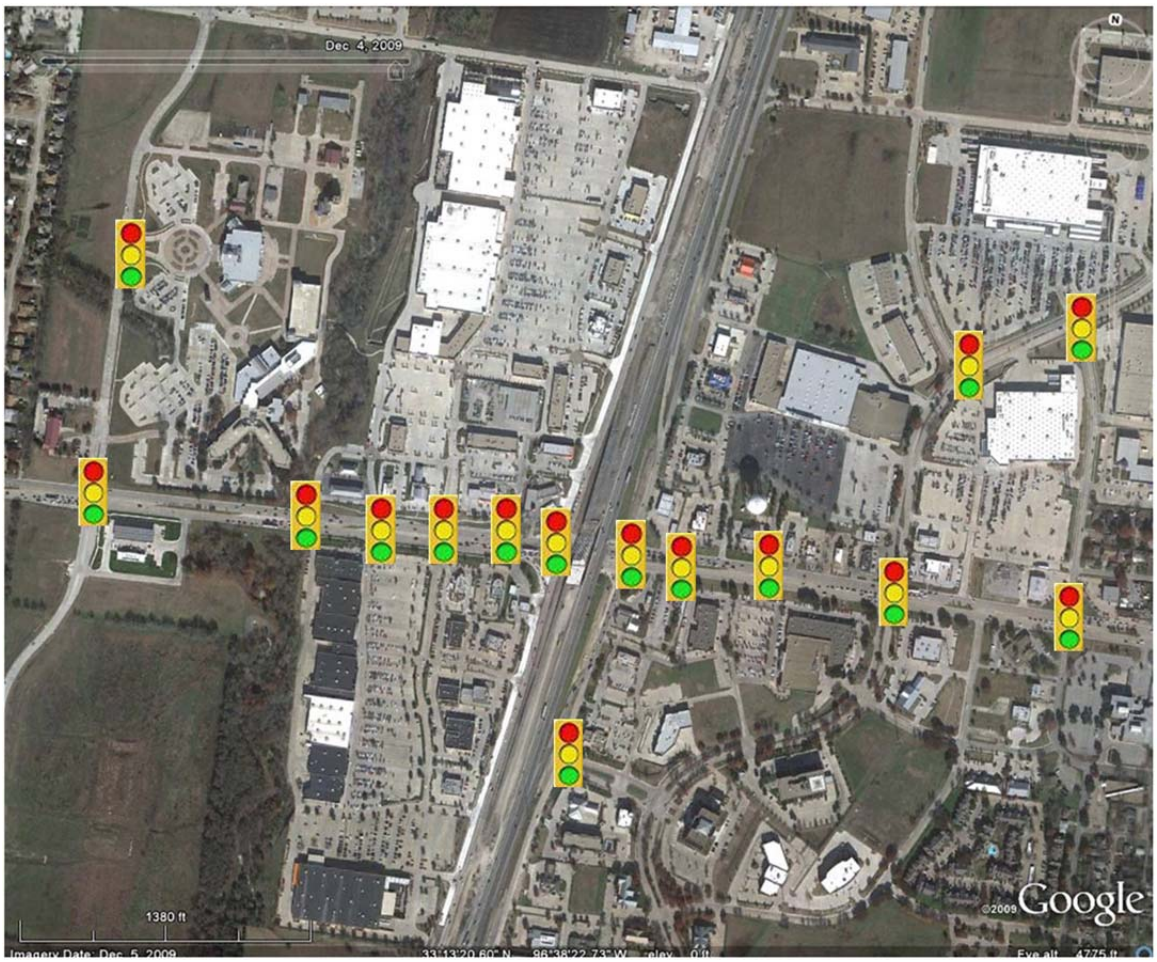
Traffic Characteristics Overview

National Avenue (Route 7) begins in the City of Hamilton and spans over 38 miles as it runs through the neighboring City of Gloucester where it becomes Berryville Pike. The area of particular interest is 2.5 miles in length and includes 15 signalized intersections with an Average Daily Traffic (ADT) volume of 56,000 and experiences constant fluctuation in traffic due to surrounding developments. The main arterial is a median divided with a 4-lane and 6-lane configuration and includes sections with urban and suburban traffic characteristics with posted speed limits from 25-45 mph, with complex intersection geometric conditions. The road capacity is constant as there are no reversible lanes or on-street parking.

Land Use

The land use on National Ave includes a university, sports arena, shopping centers, parks and other recreational facilities that create variability during special events, off-peak hours and weekends.

City of Hamilton, National Ave corridor (with major buildings highlighted and roads labeled)



City of Hamilton, National Avenue corridor (without buildings/roads highlighted)

Traffic is highly directional commuter traffic during the weekday peak periods going and exiting the urban areas of Hamilton. Traffic conditions are highly variable for the intersections that serve Newton University and other major traffic generators. Traffic signal coordination difficulties on National Ave are magnified due to heavy pedestrian activity as a result of the proximity of the University and commercial segments that represent safety and operational issues. Furthermore, there is frequent traffic signal pre-emption due to the proximity of a fire station and hospital.

Peak Periods

There are heavily directional commuter peaks along the segment. Newton University is located in the center of the City of Hamilton and for that reason is a major traffic generator controlling vehicular flow on National Ave. During the AM peak, traffic is heavily directional in the direction to the university. There are two large shopping centers located relatively closely to the university. The effect increases the traffic flow convergence cause by the university. During the PM peak, traffic is heavily directional out of the university.

Traffic counts from the 15 signalized intersections located on and in the vicinity of National Ave were analyzed by the Traffic/Transportation Planning Department to identify traffic patterns and operating conditions during the AM and PM periods. This includes intersection with Taylor Ave to the intersection with Camino St. The traffic counts were collected in a previous study commissioned by the Department in 2010. The data was collected during the periods from 6am to 6pm.

The added control delay and reduced level of service in the arterial highway is a consequence of the high and fluctuating traffic volumes observed, in combination with the road capacity restrictions in some sections, providing difficulty establishing efficient progression plans for the particular groups of intersections for the different time periods along the highway. The amount of traffic on the arterial [National Ave] imposes signal control plans assigning high green timings on the main through movements that result in excessive queues on the intersecting secondary and tertiary roads. Some of these intersecting roads are important arterial or collector highways for the city as well.

The directional factors for the traffic along National Ave intersections confirm that the

traffic pattern during the AM peak is going toward Newton University adjacent intersections from the North and South of the city, whereas the traffic distribution during the PM peak period shows the intersections near the university as breakpoints in the pattern, representing traffic exiting the city from that point.

This segment of National Ave has a high proportion of turning traffic at several intersections, due to the presence of major traffic generators in its vicinity. The traffic pattern is most common in several of the intersections located in the urban areas of the city and the commercial segments. Queues often overflow from the turn lane at the hospital access, and the shopping center at Royal Ave and Liberty Ave, during the AM peak and Western Plaza and Heritage Mall during the holiday season.

Business Hours

In the commercial sections of Hamilton, business hours flows are determined by the major traffic generators (commercial shopping area) and other special generators at the zone (fast food establishments and other commercial, retail, and service trades). During the morning business hours, the predominant flow is westbound while during the afternoon hours traffic is moving eastbound. During lunchtime periods, there are minor peaks, for the special generators.

Evenings

Traffic flow is considered balanced during the evenings after the PM peak period (after 6pm), in the commercial sections. The traffic pattern is mainly determined by the special generators in operation (movie theater, fast food establishments, and other commercial, retail, and service trades).

From Monday to Wednesday, the flow is also considered mainly balanced during the evenings in the urban area of the city after the PM peak. The traffic flow pattern is determined by the university and special generators (movie theater, fast food establishments, and other commercial, retail, and service trades). From Thursday to Saturday, there are two predominant flow patterns southbound and northbound due to the special generators in the urban area zone (social clubs, fast food establishments and other commercial, retail and service trades). On Sunday evenings, there is a major inflow of trips caused by the return of the university students to the area after the weekend of rest.

Weekends

There is a major outflow of trips from the urban area, as university students return to their homes during Friday afternoons. At this period, the flow is in the same direction as indicated to weekday PM peak periods. The remaining traffic is from local people in the area. On Sunday afternoons and evenings, there is a major inflow of students returning. During the rest of the weekend periods, the flows are related to the retail commercial places such as the malls and sporting facilities.

Pedestrians

With the university and sporting facilities in such close proximity to a major roadway with busy shopping centers, pedestrian safety is a major concern.

This completes Task 2. Complete the Critical Thinking Questions at the end of this document for Task 2. Then, continue with Task 3.

Case Study – Task 3: Operational Strategies, Constituent Interests, and Agency Goals and Objectives

You've been on the job for over a week now, and are starting to get in synch with what is going on at the office.

You've had a few days to review Mark's Project Data document and make sure that you clearly understand the project area. Mark has scheduled a team meeting in the Lake Superior Conference Room this afternoon to continue preparing for the presentation to the National Ave Traffic Coalition Committee.

You come back from lunch, grab your notebook and join your team in the conference room. Eric is taking notes.

Meeting:	**National Avenue Traffic Coalition Prep Meeting**
Date:	Tuesday, June 10, 20XX, 1p.m. – 3p.m.
Location:	Lake Superior Conference Room
Note Taker:	Eric Martin, Traffic Technician
In Attendance:	Mark Reynolds, Sr. Traffic Engineer
	Leslie Gonzales, Traffic Technician
	Eric Martin, Traffic Technician
	YOU, Jr. Traffic Engineer

Agenda:
Project Update
Background on Goals and Objectives
Next Steps

1. **Project Update**

Mark explained that now that the overview and scope of the project are clearly defined and documented, we need to articulate the necessity/urgency for addressing the traffic problems.

Mark's summary: The project data and influx of complaint letters demonstrate the current inadequacies of the signal lights on a portion of the main arterial road (National Ave). These inadequacies contribute to heavier traffic, longer commute times, user frustration, safety issues, and environmental concerns (vehicles in transit longer causes adverse air quality effects and wasted fuel).

We need to make the case that operational improvements to signalized intersections in this area will improve traffic flow, reduce commute times, meet user expectations, ensure our roads are safe, and ensure we are meeting our targets for air quality.

Per Mark, this is a key point: By highlighting what the exact problems are we will be better positioned to make the case that an adaptive system will better manage the

queues in critical intersections and recognize differing traffic conditions in various sections of the coordinated network.

2. Background – Why we need goals and objectives

Mark explained that to be seriously considered for funding we need to articulate how the strategy we suggest strongly supports our goal and operational objective. Mark emphasized how competitive funding is! Projects for the entire area are prioritized and then award funding.

Projects like this give us the opportunity to ensure our work is in line with the department's goals and objectives. If we don't have a goal/objective in mind, then solving the complaint becomes our objective. Goals and objectives provide context to the operation, and provide a filter for prioritizing and responding to complaints.

The goal of this agency as it relates to traffic signals is to keep the traffic moving, and if traffic stops, not for very long. The objectives, then, are statements of how we are going to achieve that goal. As Mark explained, to address what our objectives should be, we can think about it this way: What things do we need to do to see that the goal is met?

Funding discussion – where will the money for this project come from? Mark mentioned that we are hoping to use CMAQ (Congestion Mitigation and Air Quality) Program funds for this project. If we use CMAQ funds, we have to think about where CMAQ funds come from and what those people want to see done with CMAQ funds. We can think of those people as the customer we are serving, an important stakeholder, since they are writing the check for this project.

CMAQ funds are Federal funds. Money isn't free. There are different rules or regulations for what we need to do to receive funding from any source. Federal funds require that we write the Concept of Operations that we've been working on to substantiate the need and purpose of the money.

Mark reiterated that the goal of our agency as it relates to traffic signals is to keep the traffic moving, and if they stop, not for very long.

Mark then led the discussion: What are the appropriate SMART (operational) objectives to apply to reach the goal? He referred back to the model system engineering document.

What are the operational objectives for the signals to be coordinated?

- Smooth the flow of traffic along coordinated routes
- Maximize the throughput along coordinated routes
- Equitably serve adjacent land uses
- Manage queues, to prevent excessive queuing from reducing efficiency

- Variable, with either a combination of these objectives, or changing objectives at different times
- For a critical isolated intersection, maximize intersection efficiency

3. Next steps

- Send sampling of complaint letters received to team (Mark will send)
- Send information on operational objectives from Model System Engineering document to team (Mark will send)

At the team meeting last Tuesday, Mark mentioned that he'd send some complaint letters to you along with some information on operational objectives from the Model System Engineering document (This is a great resource for a future transportation engineer to have! You will undoubtedly see it again.). Friday morning you check your email and see that Mark's email has arrived and he has a task for you.

from: Mark Reynolds <markreynolds@statedot.gov>

to: Junior Engineer <juniorengineer@statedot.gov>

date: Fri, June 13, 20XX at 10:13 AM

subject: National Ave Complaint Letters

mailed-by: mxh1.email-od.gov

For your reference, I've attached a copy of the operational objectives from the Signal Timing Manual where the operational objectives are identified. I suggest you familiarize yourself with these. As I mentioned previously an important part of our job is maintaining the operational objectives of the department. That is why this project is so important since it's clear there are several problem areas in our town.

I'm sending you a few of the complaint letters we've received recently regarding traffic signals and volume. I need you to review these letters to identify who the stakeholders are and determine which operational objectives are not being met.

We will use these letters to help us articulate what strategies and tactics we need to utilize to ensure the operational objectives are being met.

Don't hesitate to stop by if you have any questions.
Mark

Attachment: Complaint Letters.doc
Attachment: Operational Objectives_excerpt.pdf

After reading the email, you open up the first attachment that Mark sent you, named ComplaintLetters.doc. This is what you find in that document.

Western Plaza Complaint Letter

Ms/Mr. _____

Address

Date: _____

Subject: Complaint Regarding Traffic Congestion

Dear Ms/Mr. _____

On behalf of the Western Plaza I am writing to inform you of mounting traffic congestion due to the ineffective traffic signals at the intersections of our shopping center, specifically at National Avenue and Liberty Avenue and also at National and Haymarket Street. These intersections are affecting customers' ability to efficiently access our stores during lunch time and the afternoon commute.

Traffic on National becomes so heavy during the lunch hour that customers turning left from National Ave sometimes have to wait multiple times to get through that intersection. When this happens, it causes a further back up on National Ave which in turn creates problems all the way back to National and Jameson Rd.

We are concerned that if this problem doesn't get fixed, our customers will go to other stores. Because we do not have control over the traffic lights, we are hoping that you can respond to our request to have this problem addressed. It is not only for the success of our store but the safety and good quality of life of all of our customers and community.

Yours
Alex Martinez
Manager of XX Big Box Store

Citizen Complaint

To Whom It May Concern:

I am writing regarding my frustration with our town's traffic signals. As if the frustration of the ever-growing traffic isn't enough we have to deal with inefficient traffic signals. I can't even count the number of times after turning onto National Ave from the freeway that I have had to sit at multiple red lights in the evening/afternoon commute when there is no crossing traffic. The intersection at National Ave and Baker Street is particularly infamous for this problem. Other times I have to sit through two or three changes in signals at National Ave and Haymarket St because there is such a huge backup in the left turn lane. Last week I witnessed an ambulance at the intersection have trouble getting through the intersection due to the traffic backup, and actually had to wait through one light cycle so that people could move their cars out of the way enough to let it pass.

Many of my friends and neighbors share the same concerns and outright frustration. These traffic signals are really creating problems and we'd all like to see some solutions.

Respectfully,
John House

Colony Citizen's Association Compliant

Re: Traffic Congestion

Dear Mr. Stokes,

I am writing to you on behalf of the Colony Citizen's Association. This letter is a follow up on my calls to your office regarding the morning traffic congestion at the corner of National Ave and Camino St. The high level of motor and pedestrian traffic at this intersection presents a perilous situation, which places many people at risk.

Our community is experiencing an astounding increase in the volume of traffic due to people trying to avoid the traffic signals on National Ave. As you know, many residents from Hamilton, but also from Evansville and Mooreland, use National Ave to commute into the city or to access the Interstate. Motorists have become frustrated with the long waits at the traffic lights during their morning commutes and are looking for any way to save a few minutes. They are using residential roads to get as far east as possible, before turning on National Ave.

The first problem we see is with drivers on Roland Rd. Anyone who lives in this neighborhood can tell you that the signal lights are in no way coordinated. It is frustrating to drive on Roland Rd because of the number of times you get stopped, sometimes when there is no cross-traffic. In order to try to avoid getting stopped at light, we have seen an increase in the number of cars running red lights or speeding to make a green light. The children in our neighborhood who walk to school should not have to dodge traffic so that someone can save a few minutes.

The increased traffic has also resulted in more than 10 large accidents at the intersection of Camino St and National Ave over the past year. Because the lights are not timed to account for the increase cars on this road, drivers will continue to travel through the intersection well after the light has changed, only to get stuck in the intersection because the large number of cars turning onto National Ave creates a backup.

This traffic is causing a dangerous situation for our children, who are just trying to get to school each morning. We request you to consider the matter immediately. Our children are being put in danger ultimately because the city has not adequately responded to the influx of university and shopping center traffic. The city is in jeopardy of a lawsuit that would no doubt cost far more than a traffic light.

Thank you for your prompt attention. I look forward to hearing back from you.

Sincerely,
Clara Kafenzis
President
Colony Citizen's Association
Cc: Mayor Christopher Arduini

After reading the Complaint Letters document, you open up the other attachment that Mark sent you, named OperationalObjectives_excerpt.pdf.

Here is a link to that information, available online through the Federal Highway Administration: http://ops.fhwa.dot.gov/publications/fhwahop11027/sec_d.htm

This is what you find in the document Mark sent you.

3.4 Statement of Objectives for the Improved System

This section is focused on describing the operational objectives that will be satisfied by the envisioned adaptive operation. This should NOT describe the equipment but rather HOW the equipment will be used. To describe the operational objectives of the system, answer the following question.

What are the operational objectives for the signals to be coordinated?

Smooth the flow of traffic along coordinated routes

Maximize the throughput along coordinated routes

Equitably serve adjacent land uses

Manage queues, to prevent excessive queuing from reducing efficiency

Variable, with either a combination of these objectives, or changing objectives at different times

For a critical isolated intersection, maximize intersection efficiency

In answering this question you should not limit yourself to the current situation. Consider how the objective may change over time, as new development occurs in the area, the number of signals changes and the intensity of the traffic load changes. Consider the period of time over which these changes may occur and compare that with the expected life of the envisioned adaptive system. You may need to select more than one objective as being appropriate for the system.

Smooth Flow

This objective seeks to provide a green band along an arterial road, in one or both directions, with the relationship between the intersections arranged so that once a platoon starts moving it rarely slows or stops. This may involve holding a platoon at one intersection until it can be released and not experience downstream stops. It may also involve operating non-coordinated phases at a high degree of saturation (by using the shortest possible green), within a constraint of preventing or minimizing phase failures and overflow of turn bays with limited length, and with spare time in each cycle generally reverting to the coordinated phases.

Maximize Throughput

This objective seeks to provide a broad green band along an arterial road, in one or both directions, to provide the maximum throughput along the coordinated route without causing unacceptable congestion or delay on the non-coordinated movements. The non-coordinated phases would typically be vehicle-actuated and operated at a high degree of saturation (by using the shortest possible green), within a constraint of preventing or minimizing phase failures and overflow of turn bays with limited length, and with spare time in each cycle generally reverting to the coordinated phases.

Access Equity

Traffic signals are often provided so that major traffic generators along a street can have safe and efficient access to and from the arterial. In these cases, the objective is to equitably serve all traffic movements at each intersection. At the same time, coordination is generally provided along the arterial, but not at the expense of accessibility to local land uses. An example is a suburban retail shopping district that generates significant demand for left-turn and side-street movements, with unpredictable demand characteristics during time periods that are not normally considered when developing traditional coordination plans.

Manage Queues

Where there are closely spaced intersections, such as at a diamond interchange or within a tight grid network, and especially when a short block is fed by movements from various phases, the primary objective is to ensure that queues do not block upstream intersections or movements (such as occurs when a left turn bay spills over into adjacent lanes, or left turn queues exceed the intersection spacing at a tight diamond interchange). This often requires constraints on cycle lengths and phase lengths to ensure that a large platoon does not enter a

short block if it must be stored within that block and wait for a subsequent green phase. It may also involve "gating" a movement, so that a movement is stored at an intersection simply to hold it in a location that has sufficient queuing capacity, even though other movements at the intersection may not require the green time. Multiple phase service may also be an effective tool in management of queues, especially for minor movements where queue overflows can cause problems for major movements.

Variable Objectives

It is often the case that different objectives are appropriate at different times of the day and under different traffic conditions. An arterial road that provides access between a freeway and large residential areas, but also has traffic generators such as retail centers and schools, may require an objective of providing a pipeline maximum throughput during the morning and evening peak periods, but provide access equity during business hours and on weekends, and minimizing stops during other off-peak times.

Maximize Isolated Intersection Efficiency

This objective applies to adaptive control of an isolated intersection. Intersection efficiency may be defined simply in terms of overall delay, or in a more complex objective function that considers stops and other operational parameters.

This completes Task 3. Complete the Critical Thinking Questions at the end of this document for Task 3. Then, continue with Task 4.

Case Study – Task 4: Adaptive and Non-Adaptive Technology Systems

With all you have going on in the office, it takes you a few days to categorize the complaint letters into different operational objectives. The following Tuesday, you receive an IM from Mark to check in.

Mark Reynolds: Thanks for your help mapping out the complaint letters. Showing how the operational objectives aren't being sufficiently met is a key aspect of articulating why we need new technology.

Sent at 1:28 PM on Tuesday

You: I'm glad I could help – this project has been a learning curve for me but I've been learning a ton. It makes sense that operational objectives need to be discussed at our agency so that we can tie these letters back to those objectives, otherwise, I can see how it would be difficult to organize or quantify the letters.

Mark Reynolds: That's great insight for you to have at this stage. Operational objectives give us focus. Do you have any questions at this point?

You: Well, you mentioned before that we are pursuing ASCT because it is the best fit for the traffic conditions in our area. Are our current signals too old to update?

Sent at 1:36 PM on Tuesday

Mark Reynolds: That's a question the Coalition is inevitably going to ask so I'm glad that you brought it up. We are pursuing ASCT ultimately because the limitations of developing signal timing plans are keeping us from meeting our operational objectives. Most signal controllers can implement up to 200 timing plans, however agencies only have the resources to develop between 3 and 6 timing plans. So the timing plan that we develop can't realistically address more than the peak 15 minutes. This method of developing timing plans costs the agency about $3000 per intersection. However, that investment doesn't really serve the needs throughout the entire day.

You: That's interesting. I didn't really understand those limitations before. I've been meaning to ask do you have any resources I could take a look at to get more of a background on signal timing and adaptive signal control technology, etc?

Sent at 1:43 PM on Tuesday

Mark Reynolds: Good question. There is a lot to learn. I find it helps to learn some of signal timing in context.

Mark Reynolds: I'll send you an email with a signal-timing chart related to this project to get you started.

Mark Reynolds: On the chart I'm sending you, the periods that are highlighted with yellow circles show opportunities to make the signals more consistent with the traffic at that time and manage traffic. Use this chart to see if you can articulate the limitations of traditional signal timing with variable demand conditions. For example, can you identify what the fluctuations are related to? How might this chart look on a weekend? On the night of an event at the arena?

You: Thanks, I'll take a look at the chart and work through those questions. Anything else I should be working on this week?

Mark Reynolds: I'm sending you a section from the signal-timing manual that would be good for you to familiarize yourself with. I'll send you another email with a link to a section of the Traffic Signal Timing Manual you can review with more information about ASCT, and some questions for you to think about between now and our status meeting on Friday.

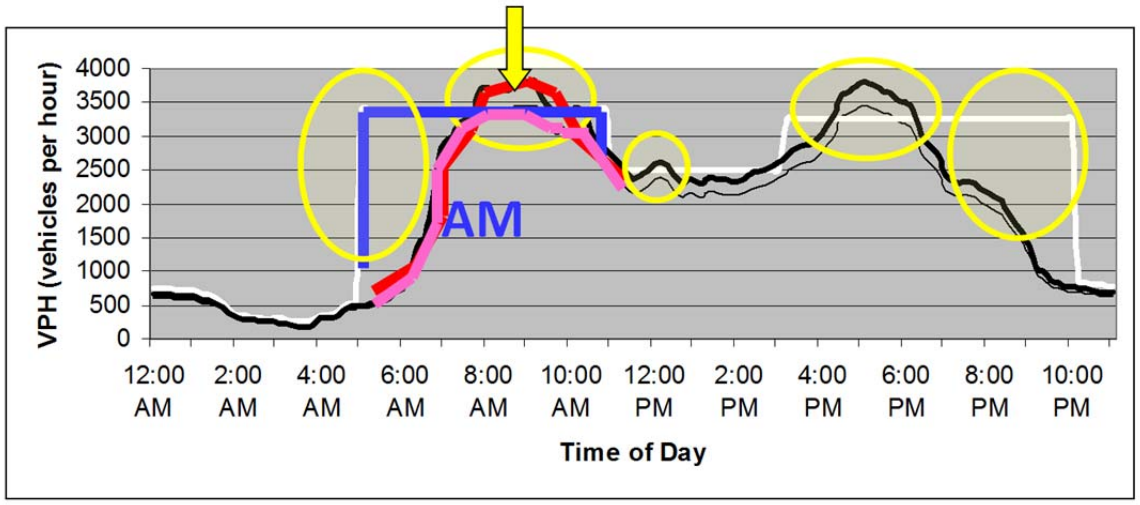
Mark Reynolds: Also, here is the link to the Federal Highway Administrations website on ASCT http://www.fhwa.dot.gov/everydaycounts/technology/adsc/ Use this website to get a better sense of ASCT (specifically intro, descriptions, case studies, and FAQs)

You: Great I'm familiar with that website from a case study we did in college. That's one of the reasons this work interested me so much during my interview!

Mark Reynolds: Ok, good. Well let me know if you have any questions otherwise we'll meet again Friday to discuss how we want to present our information to the Coalition.

Sent at 1:56 PM on Tuesday

Mark Reynolds: Here is the chart.



Sent at 1:59 PM on Tuesday

In his IM, Mark mentioned that he was going to send you additional information on ASCT from the Traffic Signal Timing Manual. His email is waiting for you the next morning when you get into the office.

from: Mark Reynolds <markreynolds@statedot.gov>

to: Junior Engineer <juniorengineer@statedot.gov>

date: Wed, June 18, 20XX at 8:58 AM

subject: ASCT Information from Traffic Signal Timing Manual

mailed-by: mxh1.email-od.gov

Here's a link to a section of the Traffic Signal Timing Manual on FHWA's website. This provides some great information on ASCT. Review this link when you get some down time. Just focus on Section 9.4 for now.

http://www.ops.fhwa.dot.gov/publications/fhwahop08024/chapter9.htm#9.4

I want you to think about the benefits of ASCT and as you read, see what is similar about the conditions described in the document and National Ave so that you can draw parallels about how we think ASCT can help us meet our operational objectives.

Let me know if you have questions.
Mark

This completes Task 4. Complete the Critical Thinking Questions at the end of this document for Task 4.

Task 1 Critical Thinking Questions

1a. What skills would you need when working as part of a technical team?

1b. Why was this project initiated?

1c. What have team members accomplished so far?

1d. What steps do you see have been taken and need to be taken?

Task 2 Critical Thinking Questions

2a. What is the configuration of the existing network or arterial?

2b. How many signals are there?

2c. What are the peak times?

2d. What are the major traffic generators?

2e. What are the land use characteristics?

Task 3 Critical Thinking Questions

3a. Characterize the traffic demands based on the observations described in each complaint letter.

3b. What would you identify as the main problem or problems to be addressed?

3c. Review the operational objectives attachment. For each letter, identify which operational objectives aren't being met.

3d. What is a stakeholder? Who are the stakeholders in this project?

3e. Why are stakeholders important; why is it important to identify who they are?

3f. Is adaptive signal control technology (ASCT) the goal, the objective, the strategy, or the tactic? Why?

3g. What are the different ways a project could be funded and why is that important to know?

Task 4 Critical Thinking Questions

4a. If you observing a signalized intersection, what would you look for to determine if the intersection was performing well or performing poorly?

4b. Using the signal-timing chart, what are the fluctuations in vehicles per hour related to? How might this chart look different on a weekend? How might this chart look different on the night of an event at the arena?

4c. What are the limitations of signal timing with variable demand conditions?

4d. How would adaptive signal control technology improve the situation? What results would you expect to see? Review the notes from Component 1 to articulate the value of adaptive signal control.

4e. Be prepared to present a 2-3 minute explanation of why adaptive signal control technology is appropriate the solution for this situation.