Autonomous Water Quality Sampler (AWQuSam)

Requirements Analysis
Florida State University Coastal & Marine Laboratory

September 23, 2011

Agenda

Friday, September 23, 2011

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- Operational Requirements
  - Environment
- Functional Requirements
  - Instrumentation
  - Data Handling
  - System Interface
- Performance Requirements
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  - Throughput
  - Precision
- Structural Requirements
  - Weight
  - Transportability
- Sustainability Requirements
  - Safety
  - Reliability
  - Maintainability
- Nonfunctional Requirements
- Constraints

Introductions - Team

- Experienced and Diverse Engineering Team
  - Project Manager – Brad Wells
  - Electrical Engineers – Triesha Fagan, Brad Wells
  - Computer Engineers – Steven Golemme, Francisco Schroeder
  - Mechanical Engineers – Carlos Sanchez, Juan Garcia

- Support
  - Dr. Kevin Speer (FSU Marine Lab)
  - Dr. Nicolas Wienders (FSU Marine Lab)
  - Dr. Michael Frank (ECE)
  - Dr. Oscar Chuy (ME)

Project Introduction

- Gather Water Quality / Hydrographic Data
- Florida Shelf
  - Shallow Environment

Operational Requirements

Operating Environment

Brad Wells

Operating Environment

3.1.1.1 Salt Atmosphere

The AWQuSam shall not suffer any degradation of performance when operated in and when stored in a salt fog atmosphere.

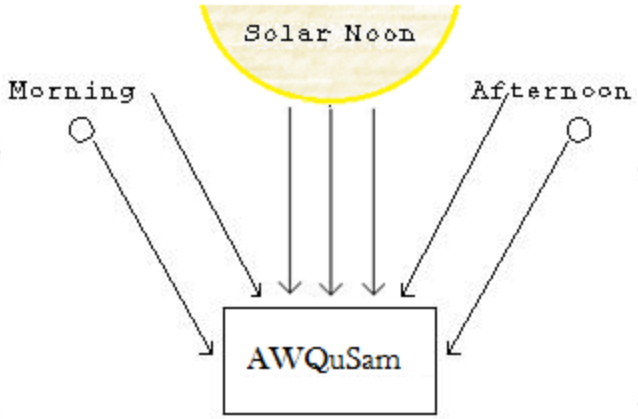
Salt speeds up corrosion

- Hygroscopic
- Increases conductivity

Operating Environment

3.1.1.2 Solar Radiation

The AWQuSam shall not be damaged by extended exposure to sunlight.



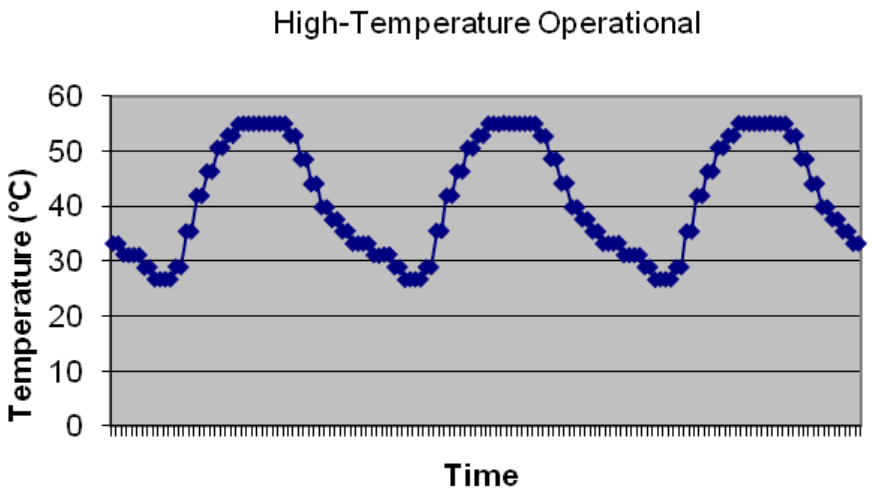
3.1.1.3 Humidity

The AWQuSam shall be operable in a hot, humid environment with a diurnal cycle peak of 100% humidity.

Operating Environment

3.1.1.4 High Temperature

The AWQuSam shall be fully operable at a continuous, ambient temperature of +55 C, and shall suffer neither damage nor degradation due to storage at a temperature of +70 C



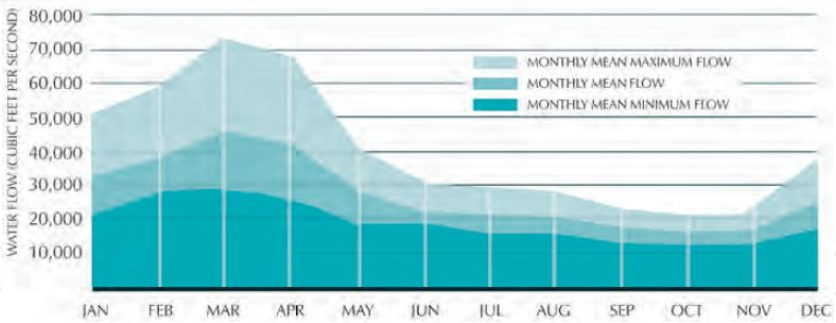
3.1.1.5 Low Temperature

The AWQuSAm shall be fully operable at a continuous ambient temperature of -5 C, and shall suffer neither damage nor degradation due to storage at a temperature of -20 C.

Operating Environment

3.1.1.6 Rain and Water

The AWQuSam shall operate and remain functional during driving rain. The vehicle instrumentation shall not suffer any damage from crashing waves up to 1m in height.



Apalachicola River/Bay Climate

- Average Annual Rainfall: 52 to 60 inches
- 73 Days of Thunderstorms Annually

3.1.1.7 Water Immersion

The AWQuSam shall remain functional after water immersion to a depth of up to 2m.

Functional Requirements

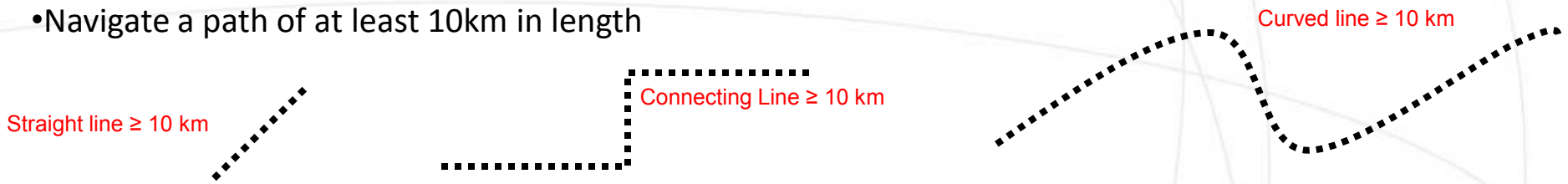
Triesha C. Fagan

Functional Requirements

3.2.1 ***Instrumentation***

3.2.1.1 Guidance and Navigation

•Navigate a path of at least 10km in length



- Plot its trajectory based on GPS reference points, obstacle information, and wave, wind and current data uploaded to it from the base station.
- Perform collision avoidance tactics.
- Be aware of propulsion systems steering angle and speed at any given time.

Functional Requirements

3.2.1.2 Measurement

- Possess the ability to measure, at a minimum, the following parameters:
  - ❖ Water Temperature
  - ❖ Water Salinity
  - ❖ Position

3.2.2 ***Data Handling***

- Log and maintain all data obtained during the mission.

3.2.2.2 Data Acquisition

- All recorded data shall be downloadable onto a base station system for analysis.

3.2.3 ***Power Management***

- Manual means to place all hardware components into an on/off mode.
- Should not require tethering to an external power source during a mission.
- Operable for at least 12 hours.
- [Optional] Report propulsion systems power level status when it detects the level has fallen to 10% of capacity.

Functional Requirements

3.2.4 ***System Interface***

Wireless Transmit

Real-time Data Transfer

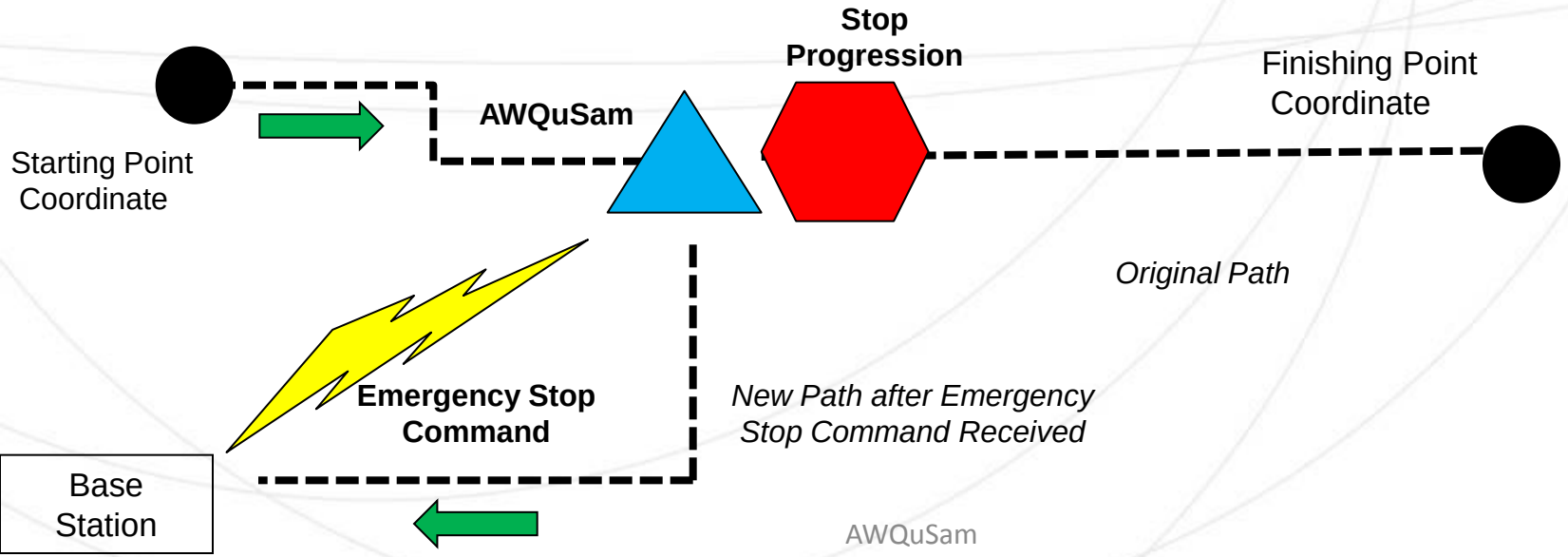
- Data recorded via AWQuSam shall be transmittable to a base station receiver over a maximum displacement of no less than 5km.

Data Transfer Rate

- A sample of data recorded via AWQuSam shall be transmitted to a base station receiver at a rate of approximately 3.33 mHz

Wireless Receive

- [Optional] Real-time Commands and Emergency Stop

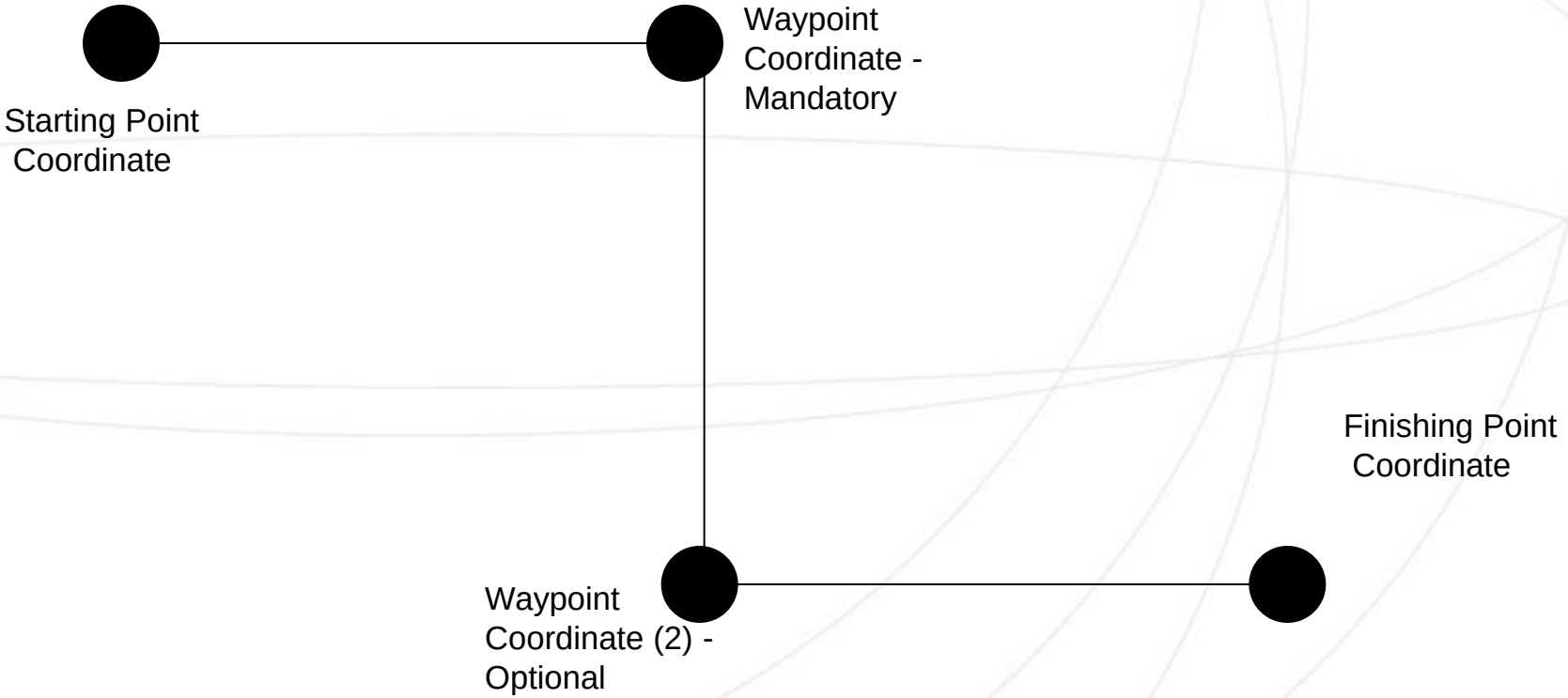


Functional Requirements

3.2.5 ***Programmability***

Configurable Paths

- Navigation path must be programmable with GPS coordinates before each mission.
- Navigation path shall, at a minimum, consist of starting point, one waypoint, and finishing point.



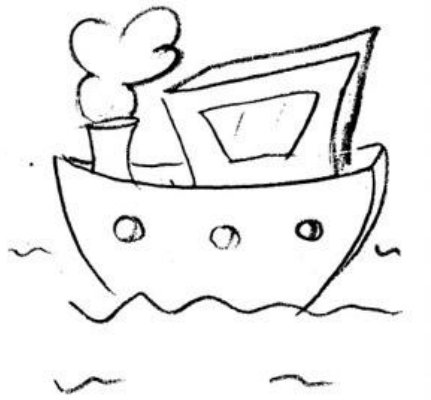
Performance Requirements

Francisco Schroeder

Performance Requirements

3.3.1 Speed

The AWQuSam shall be able to move at an average speed of at least 5 knots (2.572 m/s)



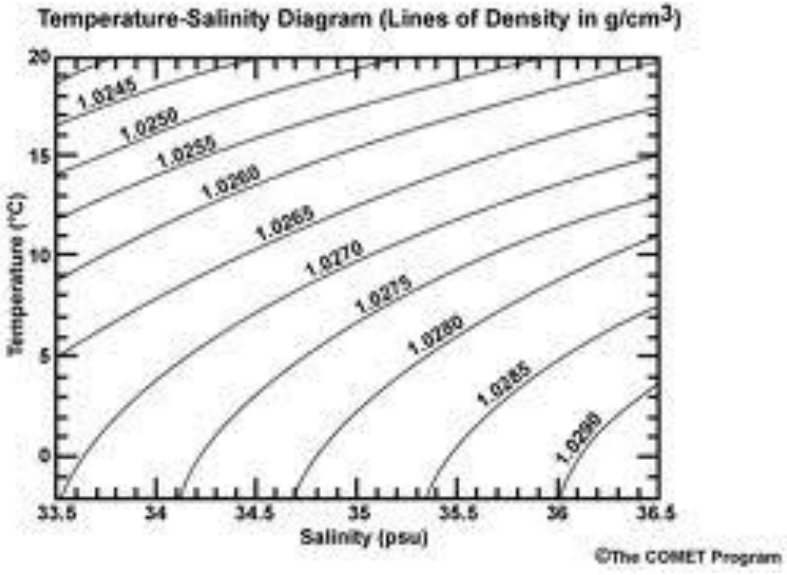
3.3.3 Stability

- Wind: 40 knots (20.578 m/s)
- Water: 5 knots (2.572 m/s)

Performance Requirements

3.3.2 Throughput

The AWQuSam shall record data at a sampling rate of no less than 8 Hz.



3.3.5 Precision

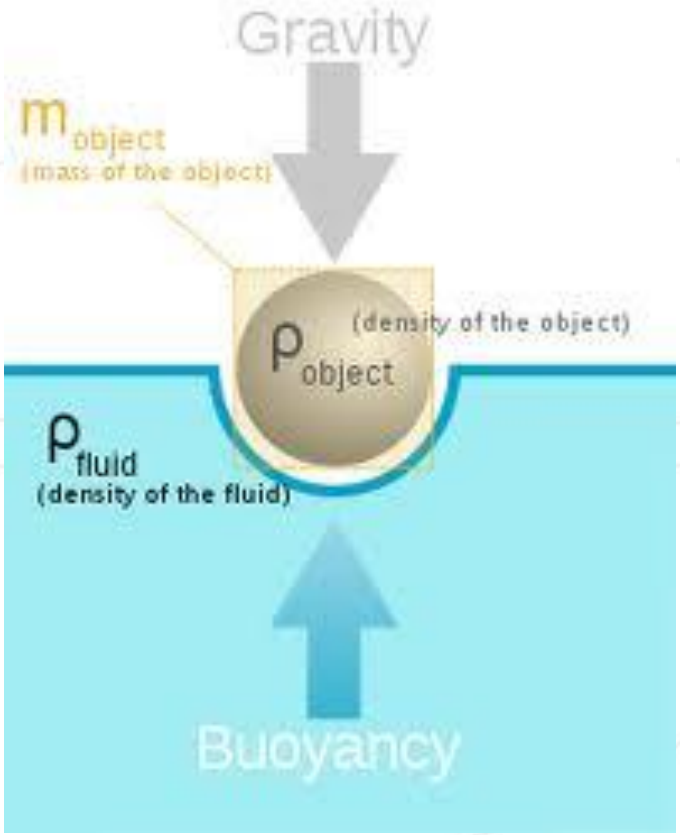
-Salinity: 0.01 ppt

-Temperature: 0.01 C.

Performance Requirements

3.3.4 Buoyancy

The AWQuSam shall be able to float at the surface of the water indefinitely.



-Placebo Masses

Structural Requirements

Juan Garcia de Paredes

Structural Requirements

3.4.1 Weight

The total weight of the AWQuSam shall not exceed 18kg.

3.4.2 Size

The AwQuSam dimensions shall not exceed:

Length: 1.2m
Width: 0.8m
Height: 0.5m (excluding antennas)

3.4.3 Transportability

The AwQuSam design shall incorporate handles to facilitate easy transportation by one or two people.

Structural Requirements

3.4.4 Propulsion/Steering

3.4.4.1 The propulsion system shall be capable of propelling the AWQuSam at an average speed of no less than 5 knots.

3.4.4.2 The propulsion system shall be capable of enduring continuous usage for at least 12 consecutive hours.

3.4.4.3 The propulsion system shall be submersible and its housing, water tight.

3.4.4.4 Steering system shall be reliable, clutter free, and simple.

3.4.4.5 In ideal conditions, the turning radius shall be no more than 3m.

Structural Requirements

3.4.5 Robustness

The AWQuSam shall withstand an accidental collision with a small boat and scraping with oyster bars.

Structural Requirements

3.4.6 Casing

All internal components shall be easily accessible when out of the water; however, when in operation all seals shall be water tight indefinitely.

Sustainability Requirements

Carlos Sanchez

Sustainability Requirements

3.5.1 Safety

3.5.1.1 Electrical Safety

The AWQuSam shall meet the electrical safety provisions identified in NFPA 70: National Electric Code.

3.5.1.2 Mechanical Safety

The AWQuSam shall include the mechanical safety provisions specified in UL 61010. Adequate provisions and markings for handling shall be provided on system components where necessary.

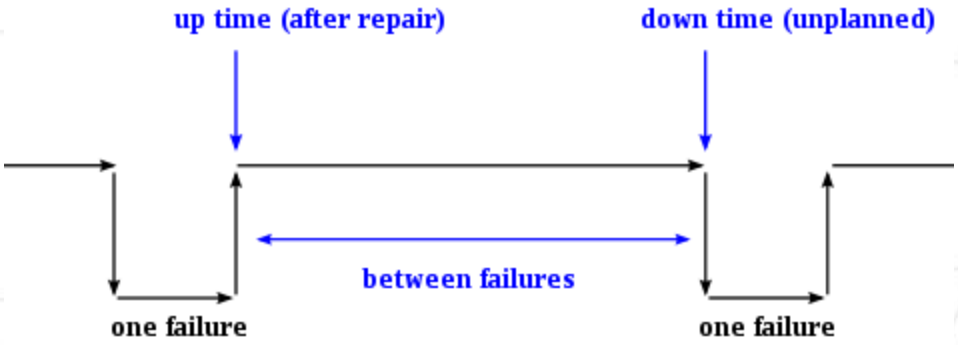
3.5.1.3 Ionizing Radiation

Use of radioactive materials shall be kept to an absolute minimum. If radioactive materials are determined to be required, the least hazardous type and form of radioisotope shall be selected.

Sustainability Requirements

3.5.2 Reliability

The AWQuSam shall be expected to operate with a Mean Time Between Failure of 2400 hours. A reliability failure is defined as any hardware or software failure (event) that results in the inability for the overall AWQuSam system to receive and process information from the sensors.



Sustainability Requirements

3.5.3 Maintainability

3.5.3.1 Serviceability

The AWQuSam shall be serviceable by an untrained person utilizing maintenance documentation.

3.5.3.2 Preventive Maintenance

The AWQuSam shall be easily disassembled, cleaned, and reassembled, with the aid of maintenance documentation.

3.5.4 Marking

The AWQuSam shall include identification that specifies the item name, user agency, and relevant contact information. Identification shall be located to prevent interference with operation of the system.

Nonfunctional Requirements

Documentation

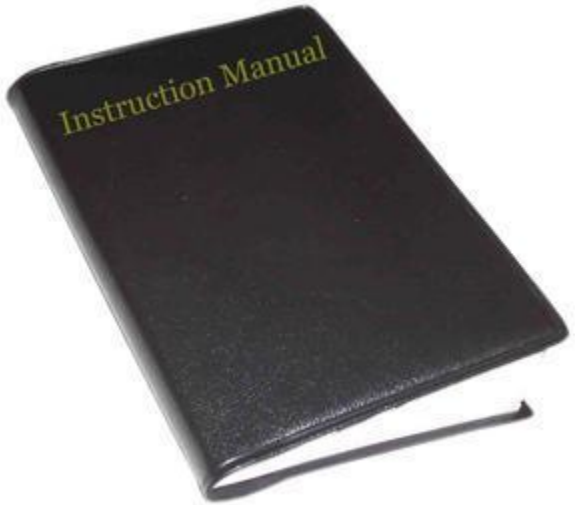
Steven Golemme

Documentation

3.6.1 Documentation

3.6.1.1 The AWQuSam shall be delivered with documentation detailing instructions for programming new paths.

3.6.1.2 The AWQuSam shall be delivered with documentation detailing instructions for performing maintenance and service of system or components.



Constraints

Steven Golemme

Budget

3.7.1 Budget

3.7.1.1 An AWQuSam prototype shall be developed with expenditures not to exceed $1000. Additional funding may be provided, with customer approval.

$500

$500

$1000

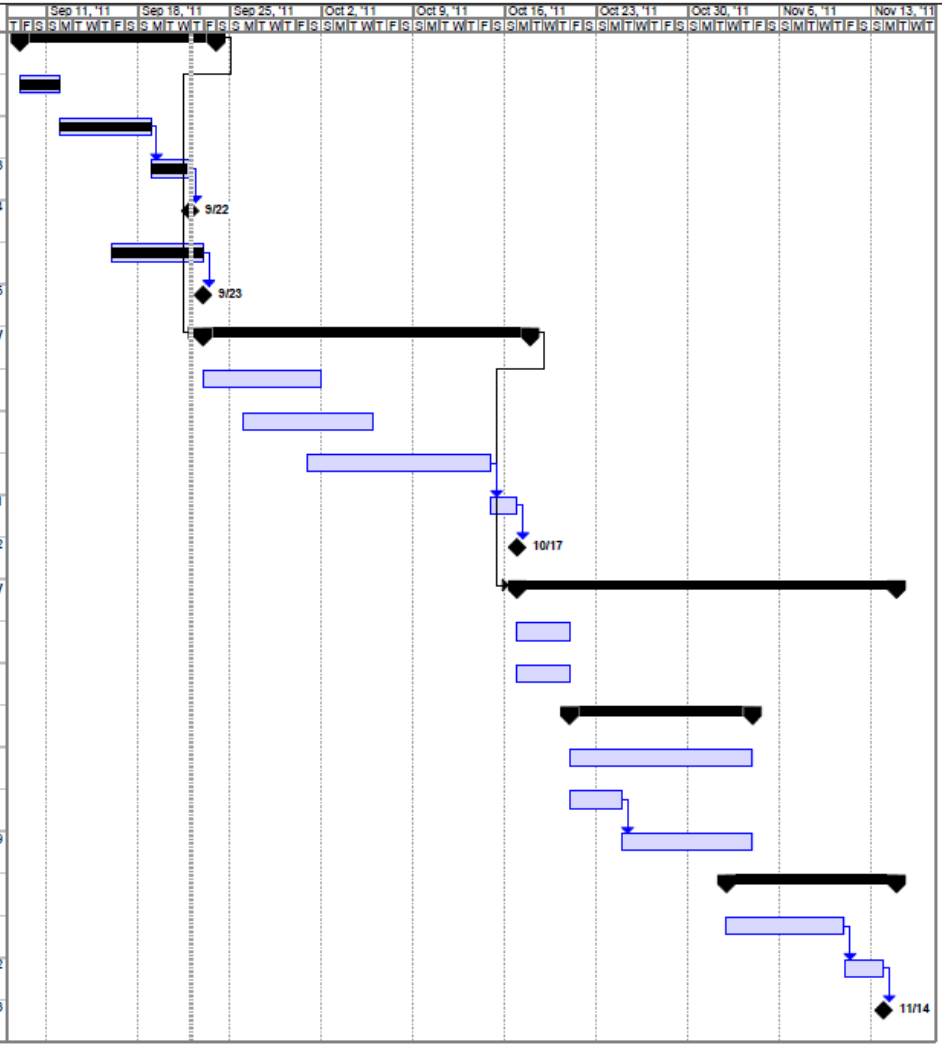
Timeline

3.7.2 Timeline

3.7.2.1 An AWQuSam prototype shall be ready for demonstration before customer no later than April 13, 2012. This demonstration shall highlight concordance with the requirements of this specification.

Project Schedule

ID	ID	WBS		Task Name	% Complete	Duration	Start	Finish	Predecessors
1	1	1		**Requirements Analysis**	**91%**	**15 days**	**Fri 9/9/11**	**Fri 9/23/11**	
2	2	1.1	✓	Gather Information from Customer	100%	3 days	Fri 9/9/11	Sun 9/11/11	
3	3	1.2	✓	Compile Documentation	100%	7 days	Mon 9/12/11	Sun 9/18/11	
4	4	1.3		Peer Review	99%	3 days	Mon 9/19/11	Wed 9/21/11	3
5	5	1.4		Submit Documentation	0%	1 day	Thu 9/22/11	Thu 9/22/11	4
6	6	1.5	✓	Develop Presentation	100%	7 days	Fri 9/16/11	Thu 9/22/11	
7	7	1.6		Give Presentation	0%	1 day	Fri 9/23/11	Fri 9/23/11	6
8	8	2		**Project Proposal**	**0%**	**25 days**	**Fri 9/23/11**	**Mon 10/17/11**	**1FS-1 day**
9	9	2.1		Discuss Possible Solutions	0%	9 days	Fri 9/23/11	Sat 10/1/11	
10	10	2.2		Gather Quotes	0%	10 days	Mon 9/26/11	Wed 10/5/11	
11	11	2.3		Compile Documentation	0%	14 days	Sat 10/1/11	Fri 10/14/11	
12	12	2.4		Peer Review	0%	2 days	Sat 10/15/11	Sun 10/16/11	11
13	13	2.5		Submit Documentation	0%	1 day	Mon 10/17/11	Mon 10/17/11	12
14	14	3		**Initial Design Review**	**0%**	**29 days**	**Mon 10/17/11**	**Mon 11/14/11**	**8FS-1 day**
15	15	3.1		Identify Engineering Design Risks	0%	4 days	Mon 10/17/11	Thu 10/20/11	
16	16	3.2		Procure Design/Analysis Tools	0%	4 days	Mon 10/17/11	Thu 10/20/11	
17	17	3.3		**Initial Design & Development**	**0%**	**14 days**	**Fri 10/21/11**	**Thu 11/3/11**	
18	18	3.3.1		Preliminary Software Development	0%	14 days	Fri 10/21/11	Thu 11/3/11	
19	19	3.3.2		Proof of Concept Hardware	0%	4 days	Fri 10/21/11	Mon 10/24/11	
20	20	3.3.3		Initial Hardware Modular Design	0%	10 days	Tue 10/25/11	Thu 11/3/11	19
21	21	3.4		**IDR Documentation**	**0%**	**13 days**	**Wed 11/2/11**	**Mon 11/14/11**	
22	22	3.4.1		Compile Documentation	0%	9 days	Wed 11/2/11	Thu 11/10/11	
23	23	3.4.2		Peer Review	0%	3 days	Fri 11/11/11	Sun 11/13/11	22
24	24	3.4.3		Submit Documentation	0%	1 day	Mon 11/14/11	Mon 11/14/11	23



Questions?

AWQuSam Engineering

Thanks Each of You