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**Document Title: SCUBA-2 Data Reduction SW  
 Project Management Plan**

**Document Number: SC2/SOF/PM210/01**

**Issue: Version 1.9**

**Date: 4<sup>th</sup> May, 2005**

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Signature and Date:

May.27<sup>th</sup>, 05



## Change Record

<b>Issue</b>	<b>Date</b>	<b>Section(s) Affected</b>	<b>Description of Change / Change Request Reference / Remarks</b>
0.1	8/01/2003	All	draft version
0.2	8/28/2003	All	Document numbering, additions, feedback to version 0.1
1.0	9/10/2003	All	Pre-Release for PDR
1.1	9/15/2003		Release for PDR
1.2	9/15/2003	Financial section	Updated budget to reflect
1.3	11/17/2003	All	New section on External dependencies, Work Breakdown Structure and Critical Path Analysis added, financial updated
1.4	11/19/2003	All	Implemented feedback from Technical lead
1.5	11/29/2003		Added references to the Compliance Matrix. This is the release for the delta PDR.
1.6	12/05/2003	Delta PDR table	Updated documentation status for delta PDR
1.7	12/27/2003		Implemented feedback from delta PDR
1.8	04/29/2005		Draft update for the CDR
1.9	05/04/2005		Incorporated feedback to the draft version



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## Introduction

This document is the Project Management Plan (PMP) for developing Data Reduction (DR) Software for use with the SCUBA-2 detector system.

The PMP provides a project managerial perspective of the DR SW development. It includes the major milestones, all the essential deliverables for the major milestones with their owners, as well as all interdependencies within the SW development team and among the various sub-projects of the SCUBA-2 development project. This document tracks the financial status of the DR Pipeline project and includes all team members with their responsibilities.

The PMP is updated for each major milestone and whenever a significant change occurs relative to the approved plan.

## Executive Summary

The SCUBA-2 Software consists of 3 main parts: the Pipeline data reduction; Off-line data reduction; and Data Display System.

The Pipeline runs at the summit, and delivers the observer a set of high quality images each night. The goal of the Pipeline is to keep up with the acquisition of data to produce co-added images for near real time estimation of signal-to-noise ratios.

The Off-line system uses the same set of routines, but can offer enhanced data reduction capabilities when run at the observer's home institution later.

The Data Display System delivers near real-time, approximate co-added images and other diagnostics to the observer as the data come in.

The SCUBA-2 Software will run on top of the JAC Observing Tool and other JCMT software. Hence the 'look and feel' from the point of view of the observer should be similar to using SCUBA with ORAC-DR, but with some important differences, particularly because of the volume of data.

Since the data will accumulate at a greater rate than for SCUBA, the Pipeline data reduction must have a level of automation which is at least as good as currently available using ORAC-DR with SCUBA.

It should not be necessary for astronomers to be familiar with sub-mm data reduction techniques in order to successfully use the instrument. However, the Software also needs

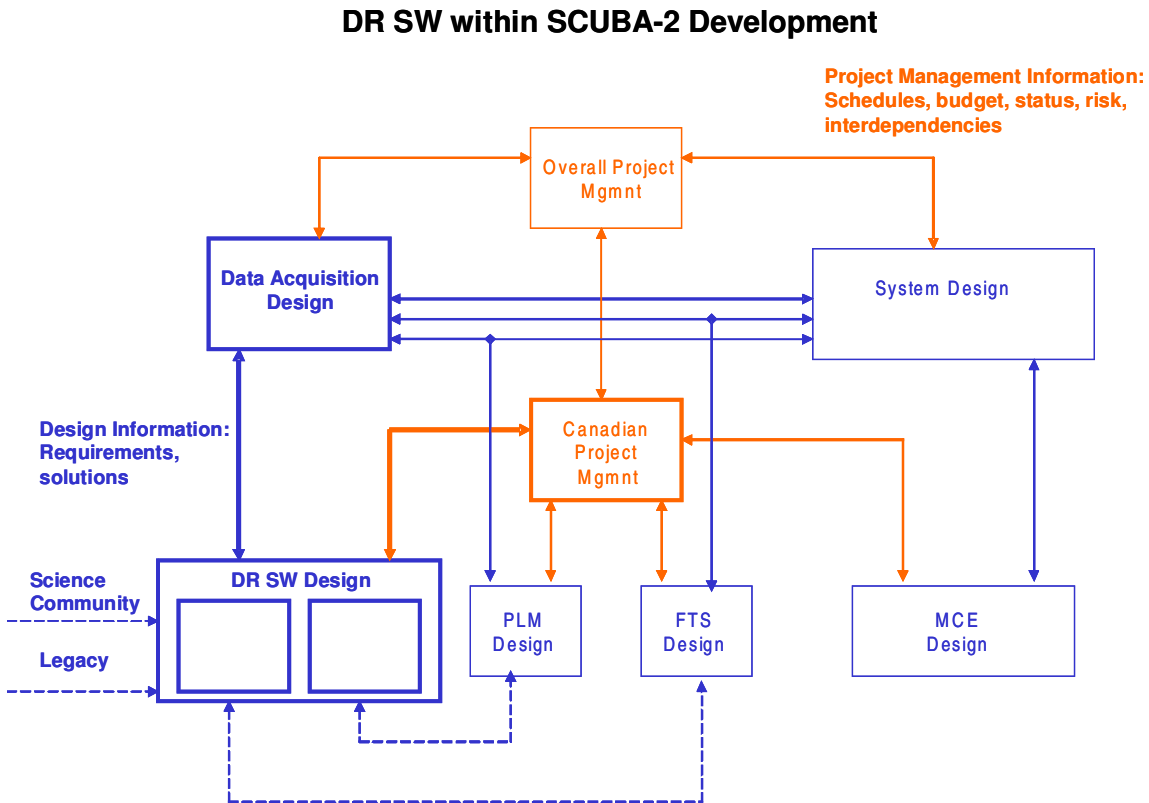


to be flexible enough for the expert user to be able to develop more sophisticated algorithms to reduce their data off-line.

## DR SW Interfaces v.s. Project Management Structure

The purpose of this section from a project management’s perspective is to organize development to provide those interfaces as separate entities, which could be developed and tested independently.

The Data Reduction Software will interface with SCUBA-2 Data Acquisition SW exclusively. This is the Data Acquisition SW development team’s responsibility to coordinate interfacing with other SW work projects, such as SCUBA-2 operating SW, FTS and Polarimeter SW interface.



**Fig.1**

It doesn't mean however, that designers working on the DR SW, Polarimeter and FTS design shouldn't directly communicate and coordinate their technical co-laboration. In



fact the project plan underlines interdependencies among the three sub-projects and both the Canadian Project Manager, who is responsible for the timely delivery of all three subprojects, as well as the overall SCUBA-2 management will ensure close cooperation between respective scientists and engineers.

## Compliance with DR SW Requirements

This is incumbent on project management that certain requirements, laid out in the DR SW Requirements document SC2/SRE/S210/001 will be met.

All software deliverables of this project shall conform to the JAC Basic Software Requirements [Req GR2] and will not require any commercial software packages in order to be used by an observer at their home institution [OR9]. The software itself will be distributed using the Gnu General Public Licence [OR10] and will be supported on the Linux, Solaris and Mac OS X operating systems.

## External Dependencies

Beside well-defined interfaces the DR SW development is dependent on external factors and deliverables, which have to be in place as defined in the detailed MS Project Plan for Data Reduction Software Development. The following table provides the list of external dependencies and work packages, which are dependent on them:

External Dependency	Delivered by		Impacting
	Prime	Date	
Instrument setup algorithm delivered	ATC	9/9/05	On-line primitives->ARRAY SET-UP
<b>Dream reduction task done (in the simulator)</b>	<b>ATC</b>	<b>4/5/04</b>	<b>On-line primitives-&gt;DREAM</b>
<b>STARE reduction task done (in the simulator)</b>	<b>ATC</b>	<b>4/19/04</b>	<b>On-line primitives-&gt;STARE</b>
SCUBA-2 ready for DR SW integration	ATC	2/6/06	Verification of final version of DR SW
SCUBA-2 ready for ATC -site commissioning	ATC	4/3/06	Commissioning DR SW
<b>Agreement on ICD</b>	<b>JAC, ATC</b>	<b>1/1/04</b>	<b>Develop Prototype QL for Dream/Stare modes</b>
<b>Add simple scanning to the simulator</b>	<b>ATC</b>	<b>2/23/04</b>	<b>Investigate simple baseline removal</b>
<b>Re-write simulator to match ICD</b>	<b>ATC</b>	<b>05/24/05</b>	<b>QuickLook-&gt;DREAM/STARE-&gt;Proto</b>
<b>Support for external data input</b>	<b>ATC</b>	<b>1/1/04</b>	<b>Investigate simple baseline removal</b>
Model updates	ATC	1/1/04	Simple cross-linking schemes
<b>Pixel heater modeling</b>	<b>ATC</b>	<b>1/1/04</b>	<b>Investigate simple baseline removal</b>
Prototype array testing complete	ATC,U BC	7/22/05	Run prototype QL, Pipeline SW on prototype SCUBA-2 system
Improved simulator based on array testing	ATC	10/22/05	Scan Map de-spiking, Optimization based on improved simulation, Develop Final version of QL in Dream/Stare modes



Polarimeter observing mode defined	UdM	6/10/05	Polarimetry pre-processing development
Sw needed for handling Polarimetry delivered	UdM	10/20/05	Testing and Integrating DR SW with Polarimetry Data
Sw needed for handling FTS delivered	UoL	10/20/05	Testing and Integrating DR SW with FTS Data

**Table.1.** External Dependencies

## Work Breakdown Structure

Table 2. below summarizes the major work packages with their estimated development effort requirements

Work Package		Estimated duration	Start Date	End Date	Primarily responsible
Number	Title				
<b>210.1</b>	<b>Architecture</b>	<b>156 days</b>	<b>2/8/05</b>	<b>9/13/05</b>	<b>TJ</b>
<b>210.2</b>	<b>Display</b>	<b>359 days</b>	<b>7/18/04</b>	<b>12/16/05</b>	<b>TJ</b>
210.2.1	QuickLook	244 days	8/24/04	8/12/05	AG
210.2.2	Stripchart (w/o KST)	109 days	7/18/04	5/20/05	AG
210.2.3	Movie	143 days	6/1/05	12/16/05	AG
<b>210.3</b>	<b>SCAN mode investigation</b>	<b>395 days</b>	<b>1/5/04</b>	<b>7/28/05</b>	<b>DS, EC</b>
<b>210.4</b>	<b>Primitives/recipes</b>	<b>313 days</b>	<b>4/8/05</b>	<b>6/20/06</b>	<b>TJ</b>
210.4.1	On-line primitives	259d	6/10/05	6/7/06	AG
210.4.2	Mosaicing primitives	20d	5/4/06	6/20/06	AG
210.4.3	Calibration primitives	25d	11/14/05	12/16/05	AG
210.4.4	Data quality parameters	25d	12/29/05	2/1/06	AG
210.4.5	Skydip primitive	25d	2/2/06	3/8/06	AG
210.4.6	Off-line primitives	65d	3/9/06	6/7/06	AG
210.4.7	Polarimeter primitives	30d	4/24/06	5/19/06	AG
<b>210.5</b>	<b>Algorithms Development</b>	<b>278 days</b>	<b>3/30/05</b>	<b>4/21/06</b>	<b>TJ</b>
210.6	FTS Infrastructure support	20 days	4/24/06	5/19/06	TJ
210.7	SW Integration Testing and Verification	20 days	6/8/06	7/5/06	TJ,BDK
210.8	Pre-delivery testing and verification (Contingency)	11 days	7/5/06	7/20/06	AG,TJ
210.9	On-site commissioning support	20 days	8/15/06	9/11/06	AG,TJ

**Table.2.** Work Breakdown Structure

## Responsibilities

Originally University of Waterloo was assigned to undertake DR SW development. After analysing available resources and understanding the demand of being lead Canadian Institution for SCUBA-2 development, this task with the necessary funding was transferred to UBC. Since JAC in general and Tim Jenness (from JAC) in particular have invaluable experience in designing and using data reduction pipelines and analysis



software, in particular for SCUBA, JAC offered its expertise and active contribution to DR SW development for SCUBA-2.

SCUBA-2 system level requirements are formulated by ATC, the system house for the instrument. SW integration and DR SW acceptance will take place by ATC's SW development team in Edinburgh. On-site support of DR SW will be finalised during the development.

The DR SW is not responsible for archiving data. The project will define a specification for the output data products that can be used as inputs for archive development work (see SC2/SOF/IC210/02).

## Project Communication Plan

Throughout the development the team is having regular bi-weekly videoconference calls, currently held every other Thursday at 11am Pacific time. Minutes of the weekly status meetings with related actions are published via email to a distribution list, called `scuba2dr_dev`.

The same vehicle is used to archive all correspondence going to this list. Interested people can contact Douglas Scott, the project scientist, at [dscott@astro.ubc.ca](mailto:dscott@astro.ubc.ca) and request to be added to the list.

There are monthly progress reports distributed through ATC as part of tracking overall SCUBA-2 development progress.

The team has also established a website, <http://scuba2.jach.hawaii.edu> where all documents of public interest are posted.

During development working documents are placed on servers, located at JAC and UBC. Document control is provided by CVS, which ensures concurrent work on the same document while maintaining the correct release and version numbers.

The technical lead and the SW Developer have bi-monthly face to face working sessions alternating between JAC and UBC sites. The purpose of these meetings is to review work accomplished during the last 6-8 weeks and take corrective actions if necessary.

## Dependencies

**Information:** All software interfaces (ATC, JAC, UBC)

**Approval:** JAC, ATC

**Acceptance:** Design will be presented to, and formal acceptance sought from ATC and JAC throughout the development process.

**Infrastructure:** Lab space and time at UBC and JAC for initial design, coding and testing. SW integration and acceptance test will be done at ATC's premises.

**Funding:** Provided by the CFI budget.



## Risks and Contingencies

DR Pipeline SW development risks are managed by the team, headed by the Project Manager. See the SCUBA-2 Data Reduction Pipeline SW development Risk Assessment document (SC2/SOF /PM210/02) for details.

Project risks are minimized and managed by three methods: a) Larger development efforts are broken down to smaller, more manageable ones, b) there are frequent internal design reviews to inspect and if possible verify smaller increments of development, spread out once in two months. Table.3 lists the design reviews, their actual and planned dates and the various features, which are planned for review. c) There is contingency time and funding allocated to address activities as listed in the SCUBA-2 Data Reduction Pipeline SW development Risk Assessment document.

Based on detailed analysis of the MS Project Plan, there was **520 hours** of contingency time by the newly graduated research assistant, whose assignment was supposed to end on Sep.20<sup>th</sup>, 2004, but he stayed on until Feb.28<sup>th</sup>, 2005. This basically consumed the allocated contingency. There was also appr. **1000 hours** of contingency time for the software developer, whose activities are funded starting Feb.9<sup>th</sup> 2004 and ending Dec.31<sup>st</sup>, 2006. In reality Dr. Andy Gibb started 5 months later on July 7<sup>th</sup>. It used up contingency time of 750 hours but left extra funding for the project. This corresponds to **~6% contingency** over the baseline time budget and **~39% contingency** on personal expenses. There is **~15% contingency** allocated for unplanned travel costs in case our SW designer has to spend time at locations for system integration and commissioning. There is no contingency allocated for equipment purchase (see risks #6 and 7) in case parallelized hardware architecture is recommended since Data Reduction computing hardware is not part of this sub-project's budget.

Review	Date	Location	Subject	Participants
1.	Jan, 04	UBC	Interview Andy Gibb	TJ, DS, JM
2.	Sep.04	UBC	Review strip chart implementation, Preliminary Map making Report	TJ, DS, AVE, AG
3.	Nov.04	JAC	Review Proto QL, Toolkit, Map Progress	TJ,AG
4.	Feb.05	UBC	Review strip chart implementation Map Research Report	TJ, DS, AVE, AG
5.	May 05	UBC	CDR, Observing modes workshop	All
6.	Aug.05	JAC	Review scanning strategy, QL for SCAN mode,	TJ, EC, AG
7.	Dec 05	UBC	Review Scan mode strategy,primitives,algorithm dev't progress	TJ, DS, EC, AG, JM
8.	Mar 06	JAC	Review Scan Mode, on-line primitives, extint correction	TJ, DS, EC, AG, JM
9.	May.06	UBC	Review FTS Infrastr, QL Scan, off-line primitives	TJ, DS, EC, AG, BG, JM
10.	Jul.06	ATC	ARR, Review Integration work, debugging	TJ, DS, AG, JM



**Table.3.** Internal design reviews

## Quality Assurance

Throughout the DR Pipeline development best practices of multi-site SW development process will be implemented. It includes practices used by JAC, tight version control, sufficiently documented functional requirements down to the smallest units of software, sufficient time allocated for regression testing, functional verification and system integration, well documented test/verification plans and execution results.

## Major milestones

In order to ensure seamless collaboration among other teams within the SCUBA-2 development effort the DR SW Development process is closely following the one established by the Astronomy Technology Centre in Edinburgh, Scotland and accepted by the entire team. See the ATC Project Management Procedures document (189/PMG/01/001) for details.

The following major milestones are implemented with their corresponding deliverables:

### Preliminary Design Review (PDR) – Sep. 24, 2003

Deliverables	Owner	Due Date	Status	As of
Data Reduction Software Requirements Document	DS	Sep. 1 <sup>st</sup> , 03	Complete	Sep. 11 <sup>th</sup> , 03
Pipeline Architecture Document	TJ	Sep. 1 <sup>st</sup>	Complete	Sep. 11 <sup>th</sup>
SCUBA-2 Data Display System	TJ	Sep. 1 <sup>st</sup>	Complete	Sep. 11 <sup>th</sup>
SCUBA-2 Data Simulation and Pipeline Testing	DS	Sep. 1 <sup>st</sup>	Complete	Sep. 11 <sup>th</sup>
Data Acquisition/Data Reduction Pipeline Interface Control Document	TJ	Sep. 1 <sup>st</sup>	Complete	Sep. 11 <sup>th</sup>
SCUBA-2 Data Reduction Recipes and Primitives	TJ	Sep. 1 <sup>st</sup>	Complete	Sep. 15 <sup>th</sup>
Project Cost (part of PMP)	JM	Sep. 1 <sup>st</sup>	Complete	Sep. 15 <sup>th</sup>
Project Schedule (part of PMP)	JM	Sep. 1 <sup>st</sup>	Complete	Sep. 15 <sup>th</sup>
Risk Assessment and Mitigation Plan	JM	Sep. 1 <sup>st</sup>	Complete	Sep. 10 <sup>th</sup>

### Delta PDR – Dec.2<sup>nd</sup>, 2003

Deliverables	Owner	Due Date	Status	As of
Data Reduction Software Requirements Document update	DS	Nov. 28 <sup>th</sup> , 03	Released for review	Nov. 29 <sup>th</sup> , 03
Pipeline Architecture Document update	TJ	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>



SCUBA-2 Data Display System	TJ	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>
SCUBA-2 Data Simulation and Pipeline Testing update	DS	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>
Data Acquisition/Data Reduction Pipeline Interface Control Document update	TJ	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>
SCUBA-2 Data Reduction Recipes and Primitives update	TJ	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>
Project Cost (part of PMP) update	JM	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>
Project Schedule (part of PMP) update	JM	Nov. 28 <sup>th</sup>	Updated	Dec.5 <sup>th</sup> ,
Risk Assessment and Mitigation Plan update	JM	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>
Compliance matrices	JM	Nov. 28 <sup>th</sup>	Released for review	Nov. 29 <sup>th</sup>

### Critical Design Review (CDR) – May 31<sup>st</sup>, 2005

Deliverables	Owners	Due Date	Status
Updated DRP SW Requirements Document	DS		
Compliance Matrix	DS,TJ,JM		
SW Integration and Test Plans	DS		
Detailed Data Simulation Description	DS, BDK		
Data Processing Recipes, primitives	TJ,AG		
Draft Acceptance Test Procedures and criteria	TJ		
Updated Data Acquisition/Data Reduction Pipeline ICD	TJ		
SCUBA-2 Pipeline Architecture	TJ		
SCUBA-2 Data Display System	TJ		
Stripchart Tool	AG		
Internal Task API			
Data throughput testing for DREAM or Stare images	AG		
Updated Project Cost (part of PMP)	JM		
Updated Project Schedule (part of PMP)	JM		
Updated Risk Assessment and Mitigation Plan	JM		

### Decision on Optimal Scanning techniques – July, 2005

Deliverables	Owner	Due Date	Status	As of
Scan Mode Investigation Report	DS			

### Acceptance Readiness Review (ARR) - July 2006

Deliverables	Owner	Due Date	Status
Test and Analysis Reports			
Acceptance Test Plan			
Preliminary operation and maintenance documentation			



Maintenance Manual			
Support Agreement			

**DR Pipeline Support - until SCUBA-2 decommissioning**

Deliverables	Owner	Due Date	Status
To be determined by the CDR and negotiated between UBC and JAC			

**Table 4.**Major milestones and milestone deliverables

## Project Financials and personnel

DR SW Development is 100% funded by the Canadian Foundation for Innovation with an original budget of CDN\$ 376,000. After detailed analysis and including foreseeable contingencies the current view of the budget is CDN\$ 361,500. Funding is granted through the Canadian Lead Institute; the Physics and Astronomy Department of the University of Waterloo. Moneys are disbursed according to a separate Agreement between the Lead Institution, which was originally assigned the task of this development and the University of British Columbia per the established schedule.

The project scientist: Douglas Scott, the project manager; Janos Molnar and one of the SW developers, Dr. Andy Gibb are located at UBC. The project also required a post doctoral research assistant (PDRA), who is to undertake data simulation and map research and whose home base is UBC.

On Jan.1<sup>st</sup>, 2004 we hired a newly graduated research assistant, Alex van Engelen, with significant experience in mapmaking research for SCUBA. Under Professor Douglas Scott’s supervision Alex temporarily, but successfully performed his map research. His work resulted in the following documents: a draft version of “Scan modes and Data Reduction Strategies for SCUBA-2” (SC2/ANA/S210/005) and “A Correlation Study using SCUBA Data, with implications for SCUBA-2 data reduction (SC2/ANA/S210/005). Two months ago we hired Dr. Ed Chapin. Dr. Chapin will join the team on July 1<sup>st</sup>, 2005. He is going to work part-time on SCUBA-2 map research.

As per current agreement between JAC and the UBC Tim Jenness is actively participating in DR SW development as technical lead. Frossie Economou is acting as JAC’s project liaison between JAC and the rest of the DR SW development team. Their



salaries are provided by JAC, and Tim's expenses, necessary to his activities (such SW development, computing HW, travel) are included in these project financials<sup>1</sup>.

The 3<sup>rd</sup> fiscal year ended on Mar.31<sup>st</sup>, 2005. The development project is funded until Dec.31<sup>st</sup>, 2006. On-site SW support will be provided until Dec.31<sup>st</sup>, 2009. Discussions are ongoing to extend the lifetime of JCMT (and SCUBA-2 with it) until 2012.

The current development cost and spending profile corresponds to the above IIA and is a snapshot as of April 30<sup>th</sup>, 2005. Spending includes expenses incurred for the PDR.

## Budget

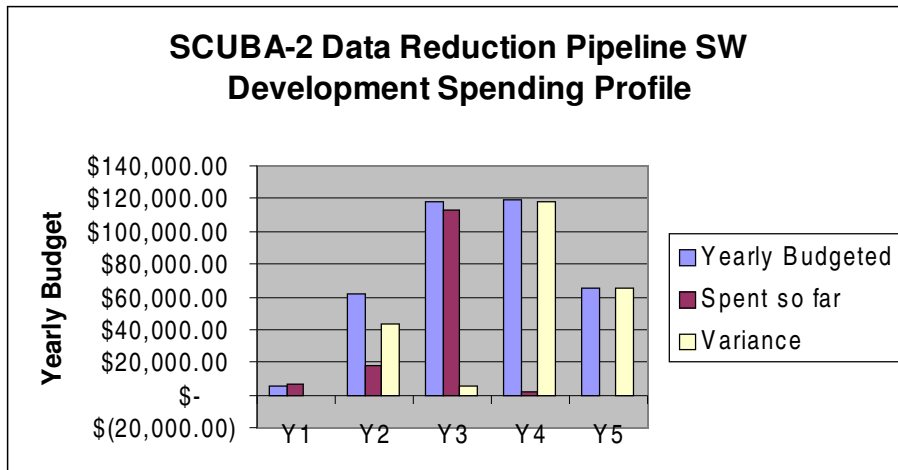
Item Description	Y1	Y2	Y3	Y4	Y5	total	Spent so far
Pipeline d_r wp: Computer (HW)	\$-	\$15,500.00	\$-		\$5,000.00	\$20,500.00	\$8,500.00
Pipeline d_r wp: Personnel	\$-	\$19,000.00	\$90,600.00	\$96,000.00	\$-	\$205,600.00	\$101,000.00
Personnel contingency		\$13,000.00	\$6,400.00	\$-	\$45,000.00	\$64,400.00	
Pipeline d_r wp: Travel	\$6,000.00	\$14,000.00	\$19,000.00	\$23,500.00	\$8,500.00	\$71,000.00	\$30,331.00
Travel contingency	\$-	\$-	\$2,500.00	\$-	\$7,500.00	\$10,000.00	
						<b>Grand total</b>	
<b>Yearly Totals</b>	<b>\$6,000.00</b>	<b>###</b>	<b>###</b>	<b>###</b>	<b>\$66,000.00</b>	<b>###</b>	<b>\$139,831.00</b>
Spent so far	\$6,868	\$18,000	\$113,000	\$1,963	\$0	\$139,831	

## Spending Profile

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<sup>1</sup> Just as an interesting note; if the project had to pay for the technical lead's salary while working on Data Reduction SW development, it would increase development cost by \$115000





## Contact list

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