

# RWI not REI a Robust report writing tool for your toughest mountaineering challenges.

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## ABSTRACT

The degree of customization required for different kinds of reports and analyses used in presentations, documents, and spreadsheets varies from one organization or department to another. Often the results needed can be achieved by using a point-and-click tool. If that is not possible, then a coded approach is required. The amount of syntax required increases depending on the SAS® procedure that you choose. However, to achieve complete flexibility, a new tool from SAS called the Report Writing Interface (RWI) is required. RWI, part of ODS, is new in SAS® 9.4. Using DATA step statements, report structures, currently not achievable with other coded method can be generated. In addition, RWI enables you to incorporate style customization anywhere. The syntax uses a common dot notation that programmers from multiple languages are familiar with. This seminar examines capabilities, examples, advantages and disadvantages of this latest reporting methodology.

## INTRODUCTION

This presentation documents features and abilities of a new data step dot notation syntax called the Report Writing Interface or RWI for short. RWI can create reporting structures and incorporate customization features not available with any SAS existing reporting procedures.

## SIMPLE REPORTING STRUCTURES

Demographics		
Cost Area	Average	Total
Ethnicity		
Melbourne	\$31,395	\$816,260
Miami-Dade	\$46,934	\$3,989,355
Philadelphia	\$45,293	\$3,079,915
San Diego	\$36,697	\$3,009,125
Sydney	\$33,452	\$1,572,235
Education		
Accounts	\$41,331	\$578,630
Accounts Management	\$44,041	\$308,290
Administration	\$29,919	\$927,480
Concession Management	\$34,320	\$274,560
Engineering	\$30,698	\$276,285
Executives	\$288,333	\$1,153,330
Group Financials	\$37,510	\$37,510
Group HR Management	\$40,754	\$611,305
IS	\$50,603	\$1,012,050
Logistics Management	\$55,735	\$668,820
Marketing	\$43,743	\$831,125
Purchasing	\$39,417	\$591,255
Sales	\$27,848	\$3,397,440

Fixed row and column cell/entity location. 3 cells per row. Uniform report structure

Display 1. Simple report analysis Fixed Row and Column Structure.



## CAPABILITIES OF EXISTING REPORTING TOOLS

### PROC PRINT

Column Dim. Only

**Sales Representative IV Report  
Country of US for Gender of M**

Fixed Formatting

Country	Gender	Employee Number	Last Name	Job Title	Date of Hire	Salary
US	M	121019	Desanctis	Sales Rep. IV	01JUN2008	\$31,320
		121022	Stevens	Sales Rep. IV	01FEB2006	\$32,210
		121026	Jaime	Sales Rep. IV	01APR2010	\$31,515

Display 4. Output generated with simple syntax from proc print.

The syntax required for print is simple, and straight forward, Limitations include sub-totals which cannot be customized. No summary analysis. Column width which cannot be adjusted.

### PROC TABULATE

Row Dim.

		Year					Total
		2007	2008	2009	2010	2011	
OrderType	CustomerCountry						
Catalog Sale	Germany	42.00	74.00	42.00	52.00	35.00	245.00
	Spain	45.00	45.00	42.00	47.00	48.00	227.00
	France	22.00	33.00	41.00	21.00	34.00	151.00
	United Kingdom	18.00	17.00	40.00	45.00	23.00	143.00
	Italy	55.00	66.00	60.00	68.00	45.00	294.00

Col Dim.

Display 5. Multi-level summary output created with Proc Tabulate.

If I need to create a summary report tabulate is my first choice. Multiple category and analysis variables can be included in the report structure. Virtually all cells in the report can be customized. Sub-Totals can be in any desired text.

### PROC REPORT

Employee Gender					
Job Title	Female		Male		AvgDiff
	Avg	Count	Avg	Count	
Sales Rep. I	\$26,305	99	\$26,491	126	\$-186
Sales Rep. II	\$27,347	78	\$27,357	96	\$-50
Sales Rep. III	\$29,707	47	\$29,393	60	\$314
Sales Rep. IV	\$32,123	27	\$31,609	25	\$514
Temp. Sales Rep.	\$26,743	39	\$26,231	43	\$184

Comparison Across Columns

Employee Name	Job Title	Employee Country	Employee Gender	Employee Hire Date	Annual Salary
Internet/Catalog Sales					
Patrick Lu	Director	Australia	Male	01JUL2007	\$163,040
Tom Zhou	Sales Manager	Australia	Male	01JUN1993	\$108,255
Wilson Dawes	Sales Manager	Australia	Male	01JAN1978	\$87,975
Kareen Billington	Administration Manager	Australia	Female	01JAN1985	\$46,230
Liz Povey	Secretary I	Australia	Female	01MAY2003	\$27,110
John Hornsey	Office Assistant II	Australia	Male	01JAN1978	\$26,960
Sherie Sheedy	Office Assistant III	Australia	Female	01FEB1978	\$30,475

Flexibility Across Rows.

**Display 6. Detail or Summary output with Proc Report. Customizations illustrated here not possible with other reporting procs.**

Proc report, because of compute blocks, can incorporate a limited amount of data step syntax. Comparisons across rows and columns, not possible with tabulate, can be accomplished here. Reports can be detail or summary reports. Sub-totals are completely customizable with multi-line executive summaries. General structure of the report, however, is fixed row and column like tabulate and print.

## DATA STEP REPORTING

ABC Furniture Manufacturing Sales Invoice Records			
Country of Sale:	Mexico	Product Type:	FURNITURE
State of Sale:	Baja California	Item Sold:	SOFA
County of Sale:			
Sales Date:	January 1, 1995		
Sales Amount:		\$188.80	
Sales Tax:		\$15.10	
Total Due:		-----	\$203.90

Independent Locations

**Display 7. Data Step Reporting with file and put statements. Oldest reporting method in the SAS system.**

This method uses data step syntax like RWI, so report content can be placed anywhere independent of a fixed location. This is the oldest reporting method. The big limitation is the restriction to the ODS Listing destination only. Style customizations are not possible.

## PURPOSE OF RWI

- Gives you the ability to create any structure, and apply any customization regardless of location.
- This reminds me of graphic annotations for reports.
- But! The code required is more voluminous and potentially complex.

## RWI SYNTAX NOTATION AND FORM

### EXPLANATION OF DOT NOTATION

```
data _null_;
declare odsout htest();
  htest.table_start(); ★
if _n_=1 then do;
  htest.row_start(type:"Header");
  htest.format_cell(text:"SASHELP.CARS",column_span:10);
  htest.row_end();
  /*partial code */
run;
```

RWI syntax is a standard dot notation language. The first part of the two-level name is the name of the object **htest**. The second part **table\_start** is the name of the method or action you want to apply to the

report. Methods have properties, which define the state or identity of the object. With the `format_cell` method the header will have a column span of ten cells.

### NESTED FORM OF THE SYNTAX

```

rep2.table_start();
  rep2.head_start();
    rep2.row_start(type:"Header");
      rep2.format_cell(text:"Summary Analysis of &statename ");
    rep2.row_end();
  rep2.head_end();
rep2.table_end();

```

For many opening RWI object and method declarations, matching closing syntax is required.

### RWI SYNTAX TIPS

#### DETERMINATION OF COLUMNS REQUIRED:

SASHELP.CARS								
Description		Specifications	Extra Areas I		Extra Areas II		EA III	
Make	Model	Suggested Price			City Driving	Hiway Driving	Walking	
MDX	Acura	\$36,945						
RSX Type S 2dr	Acura	\$23,820						
TSX 4dr	Acura	\$26,990	22.0	29.0				
TL 4dr	Acura	\$33,195	20.0	28.0				
1	2	3	4	5	6	7	8	9

**Display 8. To successfully align report structures, a determination of the maximum number of columns in some row is required**

To successfully manipulate RWI solutions, a determination must be made of the row that has the greatest number of cells.

#### COLOR NOTATION VERSES EQUAL SIGNS:

```

rep3.format_cell(data:Verbage3 , just:'L' , column_span:2 ,
inline_attr:"color=darkbrown);

```

Logically a name value pair assignment is made with an equal sign in many programming language notations. RWI use a colon for an assignment of a property. This takes some time to get use too.

#### CONSTRUCTING SYNTAX OUTSIDE METHOD ASSIGNMENTS:

```

text='-----' ||put(grandtotpop,comma14. );
Colorvalue='color=' ||put(profit,traffic.); ☺
rep2.format_text(data:text, column_span:3, style_attr:"Color=traffic.") ✖;

```

```
rep2.format_text(data:text, column_span:3, style_attr:colorvalue)); ☺
```

Constructing text programmatically and making an assignment in data step code separate from property assigns is often required to get the code to resolve correctly.

## CREATION AND RESLOVING MACRO VARIABLES

```
else %let fmt=eurox10.; ✗
hstest.format_cell(data:put(msrp,&fmt, ✗ inline_attr:"color=green ");
else call symputx('fmt','eurox10.');" ☺
hstest.format_cell(data:put(msrp, symget(fmt))☺ , inline_attr:"color=green ");
```

Macro triggers % and & are not data step syntax, and will resolve prior to data step execution. This creates a timing issue which prevents dynamic construction of text strings. With data step macro routines CALL SYMPUTX or the SYMGET function must be used.

## EXTENDED CAPABILITIES OF RWI

### HEADING STRUCTURES:

SASHELP.CARS						
Description	Specifications	Extra Areas I	Extra Areas II	EA III		
Make	Model	Suggested Price	City Driving	Hiway Driving	Walking	
MDX	Acura	\$36,945				

**Display 9.** Normally data in the body of a report is aligned to the heading structure at the top with RWI the two are separate and independent.

Notice the circled area associated with Model, Acura and the Suggested Price value of \$36,945 both have content under this area. Normally Acura would be the only value under model, but in this analysis the suggested price value starts in Model field. The body content and heading structure are independently defined in different areas of data step code.

### FOOTER STRUCTURES:

Graham	28771	814
Currituck	27973	0
Camden	27976	0
<b>Total: 11,228,377</b>		

**Display 10.** Dedicated footer methods in RWI allow any kind of complex or simple potentially multi-line footer structure to be placed at the bottom of the report.

Data step code of virtually any complexity and form can be used to create any desired footer section. The user is only limited by their creativity.

```

rep2.footer_start();
    rep2.row_start();
        rep2.format_cell(text:verbage, column_span:3, inline_attr:"Color=Green");
    rep2.row_end();
rep2.footer_end();

```

### COLUMN FLEXIBILITY

MDX	Acura	\$36,945	17.0	23.0
RSX Type S 2dr	Acura	\$23,820	24.0	31.0
TSX 4dr	Acura	\$26,990	22.0	29.0

**Display 21. Column locations, widths, borders can be custom and completely varied from one row to the next.**

Columns of data in a report body are not fixed. Notice in display 11 the green revenue information varies from one row to the next. RWI is the only location where this is possible (Sample syntax shown below.)

```

If msrp > 30000 then do;
    htest.format_cell(data:put(msrp,dollar8.) , column_span:2, inline_attr:.....
    htest.format_cell(data:put(mpg_city,5.1) , column_span:1, inline_attr:.....;
    htest.format_cell(data:put(mpg_highway,5.1), column_span:2,inline_attr:.....;
end;

```

### ROW FLEXIBILITY

		\$46,100	18.0	24.0	
2		\$89,765	17.0	24.0	
1		\$25,940	22.0	31.0	
A4 3.0 4dr	Audi		\$31,840	20.0	28.0
<b>Audi</b>	<b>A4 3.0 Quattro 4dr manual</b>		<b>€33,430</b>	<b>17.0</b>	28.0

**Display 32. The thickness of a row from one to the next can be varied. Possibly a couple of words are required in one row, and three or four sentences for the next.**

Notice the red row\_span:2 property. This can be varied for any row/column combination.

```

rep1.format_cell(data:make, inline_attr:"color=yellow row_span:2);
rep1.format_cell(data:put(msrp,euro8.), inline_attr:"color=green
fontweight=bold , row_span:2);

```

## FORMATTING CAPABILITIES

TSX 4dr	Acura	€26,990	22.0	29.0
TL 4dr	Acura	\$33,195	20.0	28.0
3.5 RL 4dr	Acura	¥43,755.0	18.0	24.0

Display 43. Formatting can be varied not only across rows but potentially across columns as well.

Formatted values can be programmatically changed from one row to the next, and frankly the syntax is easier, and application more consistent than with proc report using compute blocks embedded with call define.

```
if mod(I,2)=0 and I in (1,3) then call symputx('fmt','dollar8.');
```

```
if mod(I,2)=0 and I in (5) then call symputx('fmt','yen8.1');
```

```
else call symputx('fmt','eurox10.');
```

```
htest.format_cell(data:put(msrp,symget(fmt)),inline_attr:"color=green  
fontweight=bold fontsize=6");
```

## STYLE ENHANCEMENTS

A4 3.0 4dr	Audi	\$31,840	20.0	28.0
Audi	A4 3.0 Quattro 4dr manual	€33,430	17.0	26.0

Display 54. The appearance of text across any row or column combination can be completely . Custom fonts, sizes, color, weight, style.

An extensive set of customizations can be applied using the Style Attribute List website. Independent of row or column locations. One with a row or column cell can be completely different than another.

Very Useful style list website.

<http://go.documentation.sas.com/?docsetId=odsug&docsetTarget=n0otdo2g12obp3n0zmnghcn7p4vu.htm&docsetVersion=9.4&locale=en>

## MULTI-TASKING with RWI

Summary Analysis of Top Counties in North Carolina		
County Name	Zipcode	Total Population
Large Metropolitan Counties		
Forsyth	27199	5,807,871
Mecklenburg	28134	890,967
Wake	27597	669,034
Guilford	27377	365,812
Durham	27572	204,069

Display 65. This basic report was generated entirely with RWI and Data step syntax. Merging of tables, using hash object to sort in memory, summarization and custom reporting were all handled in one step.

An equivalent solution employing other methods would require multiple processing steps. In each ,inbound and outbound I/O segments would be expended. If a user were processing a large table with millions of records, only having one step as opposed to 5 or 6, would dramatically reduce the runtime of the overall process.

```

/**Declare a Hash Object **/
if _n_=1 then do;
    declare hash final(ordered:'descending',multidata:'Y');
    final.definekey('totpop','state','county');
    final.definedata('statername','countynm','zip','totpop');
    final.definedone();
    declare hiter f('final');
...
/**Later in the solution the work with Merging **/...
    merge work.cities end=d1
        work.zippy(keep=state county city zip countynm);

/** Then Summarizing with Hash Object **/
do until(rc ne 0);
    track+1;
    if track=1 then rc=f.first();
    grandtotpop+totpop;
    rc=f.next();
end;

/**Then Reporting **/

repl.format_cell(data:make, inline_attr:"color=yellow row_span:2");
repl.format_cell(data:put(msrp,euro8.), inline_attr:"color=green
fontWeight=bold , row_span:2");

```

## RWI AND MACRO

%MAKEREP(state gender age\_group ,actual, mean sum, dollar14 eurox14, Demographics)

Cost Areas to watch for 1998		
Cost Area	Demographics	
	Average	Total
State of Residence		
California	\$36,697	\$3,009,125
Florida	\$46,934	\$3,989,355
Pennsylvania	\$45,293	\$3,079,915
Gender		
Female	\$37,003	€5.143.400
Male	\$43,334	€7.323.490

**Display 16.** The data step code using RWI can be complex and significant in-terms of code required.

If the routine is converted into a sas macro, simple left to right parameters make structure modification and content changes much easier.

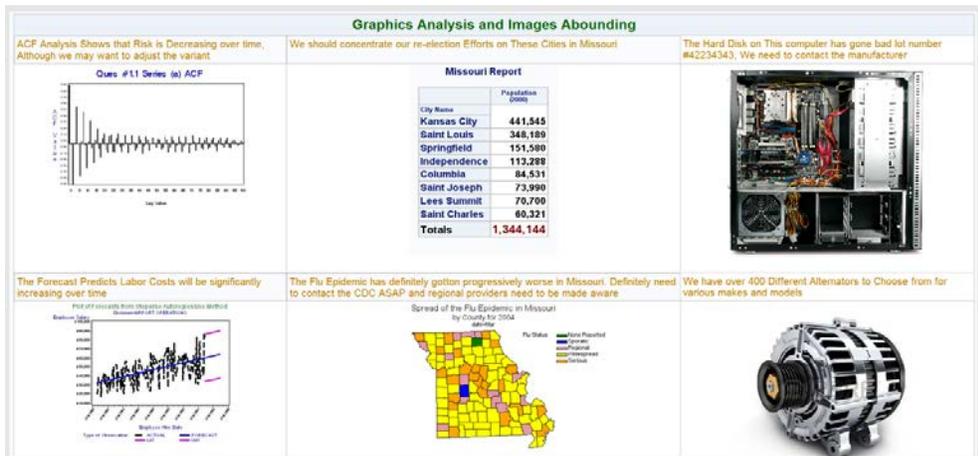
## ANIMATIONS

3.5 RL 4dr	Acura	\$43,755	18.0	24.0	
3.5 RL w/Navigation 4dr	Acura	\$46,100	18.0	24.0	

**Display 77. Animation and Static images can be incorporated into RWI output. (This will be demoed during the presentation)**

The presenter has developed routines, which will animate any Unicode character, or text string. Graphic animations embedded in an RWI report will also be displayed.

## GRAPHICS AND IMAGES



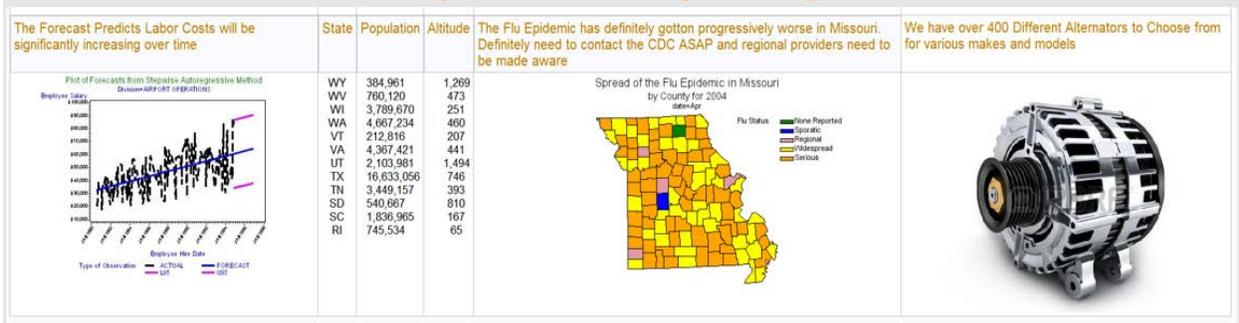
**Display 88. Multi-panel displays can be created with RWI incorporating SAS and other kinds of output. (Sample syntax shown below)**

```
rep3.format_cell(inline_attr="preimage='c:\public\Global Forum RWI\image1.jpg'");
```

```
rep3.format_cell(inline_attr="preimage='c:\public\Global Forum RWI\strep25.png'");
```

```
rep3.format_cell(inline_attr="preimage='c:\public\Global Forum RWI\inside_the_box.png'");
```

RWI and data step flexibility allows these elements to be incorporated independent of location.



**Display 99.** The previous analysis has been modified to include a multi-line report associated with a single image entity.

No reporting tool other than RWI can associate a single entity with a multi-cell entity.

## VIDEO AND AUDIO

What to do in Colorado??

Why go Skiing of Course

<p>Start out by taking lessons * First do the Ski Plow **Then Learn the Stem Christie ***Followed by Parrallel Skiing at Vail</p>	<p>Start out by taking lessons * First do the Ski Plow **Then Learn the Stem Christie ***Followed by Parrallel Skiing at Breck</p>
	
<p>Start out by taking lessons * First do the Ski Plow **Then Learn the Stem Christie ***Followed by Parrallel Skiing at Winter Park</p>	<p>Start out by taking lessons * First do the Ski Plow **Then Learn the Stem Christie ***Followed by Parrallel Skiing at Steamboat</p>
	

**Display 20.** If a user has SAS9.4M4 or above, video can be added to multi-panel displays using RWI and ODS layout gridded in combination. (This will be demoed during the presentation)

Video can only be utilized with RWI. Proc report, tabulate, and print can reference a URL with video content, but navigation away from the original website is required. In RWI the video displays within the gridded layout

## VIDEO AND AUDIO REQUIREMENTS:

- HTML5 or later.
- SAS9.4M4 or later.
- For organized structures must use layout gridded RWI form.

## ODS DESTINATION FUNCTIONALITY:

- RWI syntax can be used with ODS Mark Up (HTML4 and 5, MSOFFICE2K, EXCEL EXCELXP, etc.)

For info on Mark-up destinations:

<http://support.sas.com/rnd/base/ods/odsmarkup/index.html>.

- RWI syntax can also be utilized with Printer destinations. PDF, PCL and PRINTER.

## LIMITATION ENCOUNTERED

### PROC DS2 AND RWI

- Ultimately at part of this presentation, I wanted to be able to multi-task using RWI and DS2 capabilities.
- Scenarios could then be created, where remote database data in a multi-threaded environment could be quickly summarized and then used with any report structure.
- I could not get RWI notation to be recognized from within proc ds2 syntax per SAS94M5

### ODS Layout and RWI

- Layout methods available to RWI allow multiple pieces of output to be combined into a single display.
- But unlike ODS Layout, RWI does not allow the embedding of procedure syntax in the overall notation.
- Output from proc tabulate, and split cannot be easily combined with report structures from RWI.
- The overall notation is much easier to work with strictly from ODS Layout.

### LAYOUT GRIDDED AND RWI:

- Video and Audio are displayed sequentially top to bottom with basic RWI syntax.
- To get this kind of media in a structured tabular form with elements side to side and top to bottom, Layout Gridded using RWI notation must be used.
- ODS Layout outside the RWI realm cannot display video and audio.

### PROC DS2 AND RWI:

- Ultimately at part of this presentation, I wanted to be able to multi-task using RWI and DS2 capabilities.
- Scenarios could then be created, where remote database data in a multi-threaded environment could be quickly summarized and then used with any report structure.
- I could not get RWI notation to be recognized from within proc ds2 syntax per SAS94M5.

## CONCLUSION

Standard uniform reporting structures can be generated with common SAS procedures like print, tabulate, and report. If a non-standard structure is required then a Report Writing Interface (RWI) solution will have to be implemented. Further, overall processing step requirements can be significantly reduced with RWI, dramatically improving the efficiency of the overall program. Style enhancements can also be applied to any cell. With this tool, a proficient/creative data step programmer has unlimited capabilities. RWI does have drawbacks, the volume and complexity of the code required increases with this methodology. To justify the additional development time required for a complex report structure, the form should be extensively utilized by the organization.

## REFERENCES

GLOBAL FORUM PAPER SAS5762-2016 BY CYNTHIA ZENDER

## USEFUL DOCUMENTATION

- Report Writing Interface:  
<http://go.documentation.sas.com/?docsetId=odsadvug&docsetTarget=n0ys4rvjs0i2ukn0znadr0qtu2qs.htm&docsetVersion=9.4&locale=en>
- Style Attribute List  
<http://go.documentation.sas.com/?docsetId=odsug&docsetTarget=n0otdo2g12obp3n0zmnghcn7p4vu.htm&docsetVersion=9.4&locale=en>
- A copy of all the programs are available upon request Ted.Durie@sas.com