



12d International Innovation Awards



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2016

Duncan Whiteley

Automated Engineering Plans

WINNER: 'BANISHING THE DRAFTING DEMON'



Name:	Duncan Whiteley
Position:	Undergraduate Civil Engineer
Company:	PCB
Name Project:	Automated Engineering Plans - Quality Management
Client:	N/A

Category:

- ☐ Design & Visualisation
- ☐ Survey & Construction
- ☐ Drainage, Sewer, Utilities & Rivers
- ☒ Customisation
- ☐ 12d Synergy



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Description of Project:

- The aim of the project is to improve productivity and reduce human error. This will be achieved by:
- Remove the manual step between drafting and design.
- Implement a method for automated version and revision control
- Automate or improve routine tasks
- Remove the need for AutoCAD use 12d only for drafting

Description of problem faced / task undertaken:

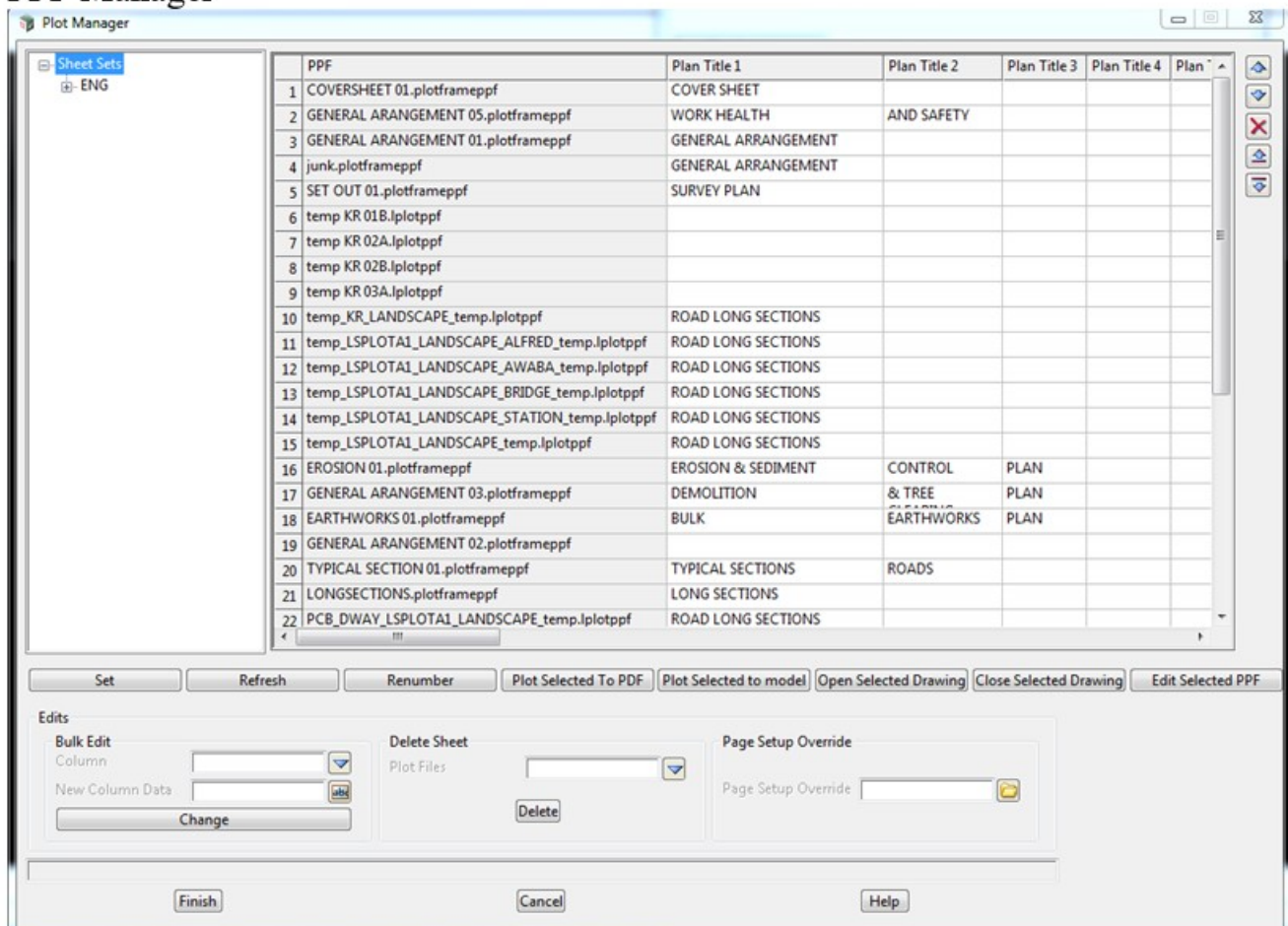
- Lack of integration between 12d and AutoCAD
- Lack of Quality Management System
- Lacks revision and version management

How the problem was solved:

- Through the use of Macros and Chains
- Refer to PowerPoint and attached pdf

Relevant 12d screenshots and/or data attached:

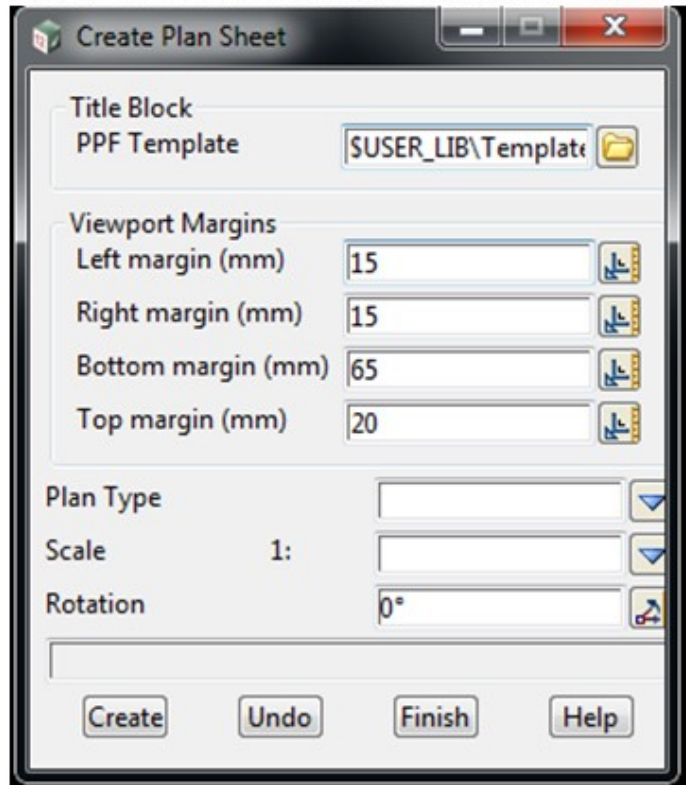
- PPF Manager





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- Combined Plot Frame and PPF Creator



INDUSTRIAL PROJECT
SOFTWARE DEVELOPMENT
AUTOMATED ENGINEERING
PLANS
QUALITY MANAGEMENT
SYSTEM

Duncan Whiteley (C3130707)

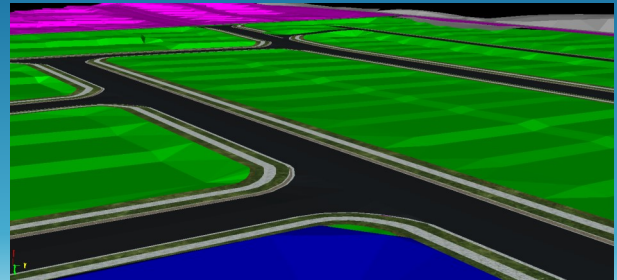
Supervisor - Chet Vignes



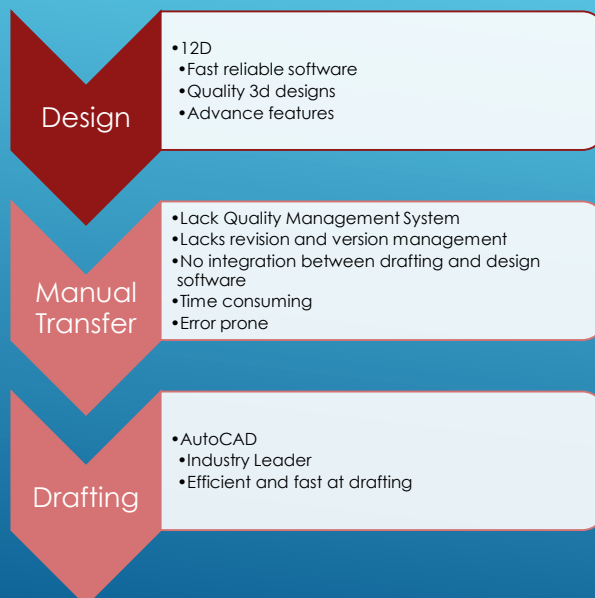
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INTRO

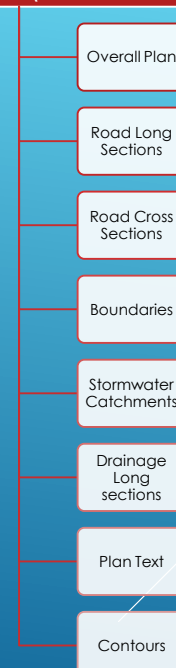
- Industrial Project – Pulver Cooper & Blackley
- 5 Years Experience – Design, Drafting, Project Management & Surveying
- Inefficient and errors in drafting and design integration
- Improve Quality Management System
- Integrate Design and Drafting software



BACKGROUND HISTORY



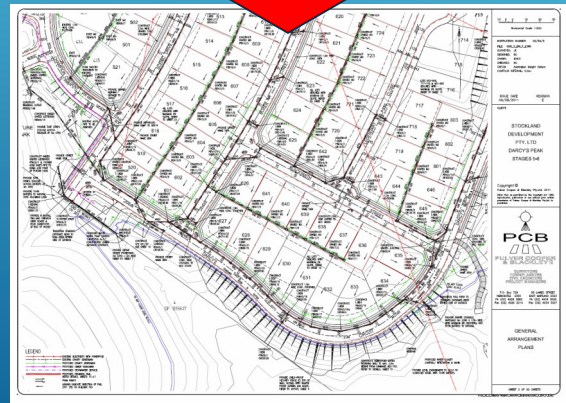
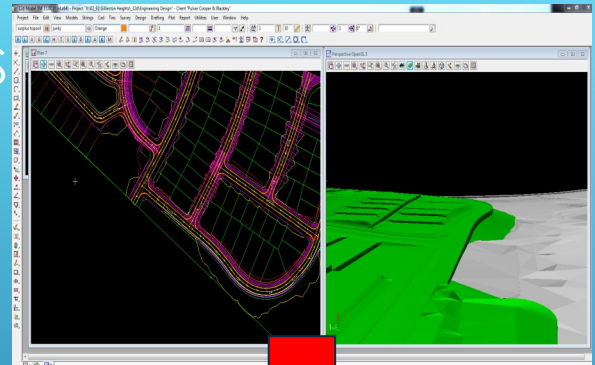
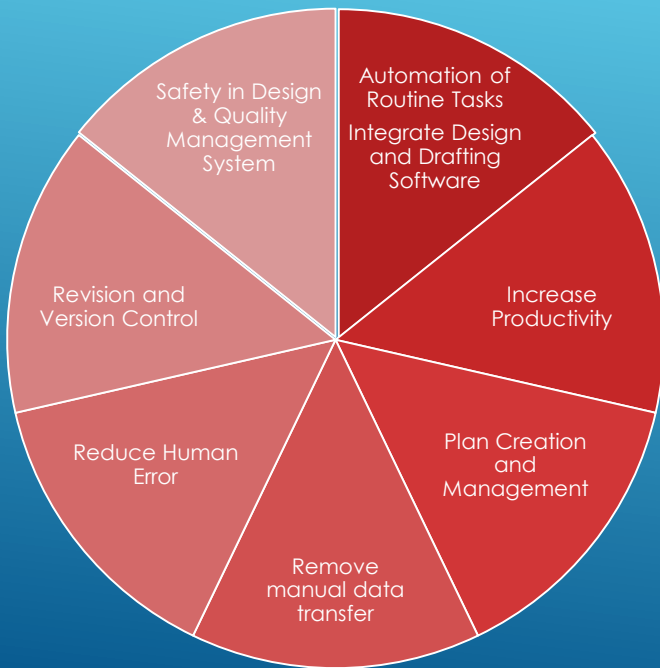
Road Design Modifications (Possible Plan Changes)



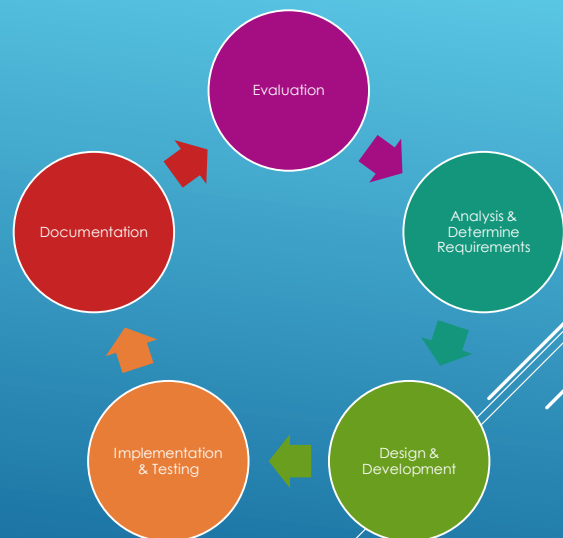


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PROJECT AIMS AND OBJECTIVES



METHODOLOGY – PROGRAM LIFE CYCLE





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RESULTS – PROGRAM LIFECYCLES

Phase 1

- Assess Alternate software options
- Autocad & 12d (Current System)
- BricsCAD & 12d
- Modified 12d
- AutoCAD & Civil3d
- Other Software Options; CivilCAD, MXroads
- Determined alternative software not viable
- 12D Required for design software

Phase 2

- Trial inbuilt 12d drafting features
- Provide training on inbuilt features
- Discover limitations of software
- Learn C++

Phase 3

- Determine priority of feature improvements, design and implement new features
- Implement in-house coded drafting addons
- Discontinue AutoCAD use.

Phase 4

- Implement newly coded features
- Start user manual for newly obtained features

PROJECT TASKS

```
File Edit Search View Encoding Language Settings Macro Run TextFX Plugins Window ? *M:\_USER\Google Drive\Final Year Project
TEXT_Parallel.dgn
159 // Determines if point 3 lies on circle going through points 1 and 2 with radius R.
160 // Returns 0 if successful also outputs k and y coord of center of circle.
161 Integer 3rdpt_on_circle(Real x1, Real y1, Real x2, Real y2, Real x3, Real y3, Real r, Real kx, Real ky) {
162   Integer Pass = 1;
163   Real q, d, kx, yy, xtemp, ytemp;
164   r = Absolute(r);
165   q = Sqrt(Pow((x2-x1),2.00) + Pow((y2-y1),2.00)); //distance between points 1 & 2
166   //midway point
167   kx = (x1+x2) / 2.00;
168   yy = (y1+y2) / 2.00;
169
170   //possible circle center solution 1
171   xtemp = kx + Sqrt(Pow(r,2.00)-Pow((q/2),2.00))* (y1-y2)/q;
172   ytemp = yy + Sqrt(Pow(r,2.00)-Pow((q/2),2.00))* (x2-x1)/q;
173
174   //check if 3rd point lies on circle
175   d = Sqrt(Pow((x3-xtemp),2.00) + Pow((y3-ytemp),2.00));
176   if (Absolute(d-r)<0.01)
177   {
178     Pass = 0;
179     kx=xtemp;
180     yy=ytemp;
181   }
182   //possible solution 2
183   xtemp = kx - Sqrt(Pow(r,2.00)-Pow((q/2),2.00))* (y1-y2)/q;
184   ytemp = yy - Sqrt(Pow(r,2.00)-Pow((q/2),2.00))* (x2-x1)/q;
185
186   //check if 3rd point lies on circle
187   d = Sqrt(Pow((x3-xtemp),2.00) + Pow((y3-ytemp),2.00));
188   if (Absolute(d-r)<0.1) { //if <0.1 close enough some accuracy lost in equations and input method.
189     Pass = 0;
190     kx=xtemp;
191     yy=ytemp;
192   }
193   return (Pass);
194 }
```

Plan Creation and Management

- Automate transfer between 3d design data and 2d plans
- Create and implement Version and revision management system
- "One Button Push" Plan Creation

Improve Drafting Functionality

- Improve Productivity
- Create new software to improve productivity

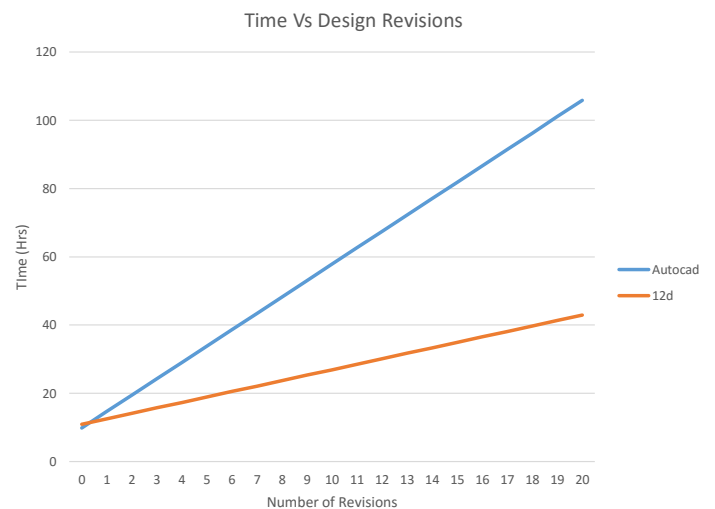
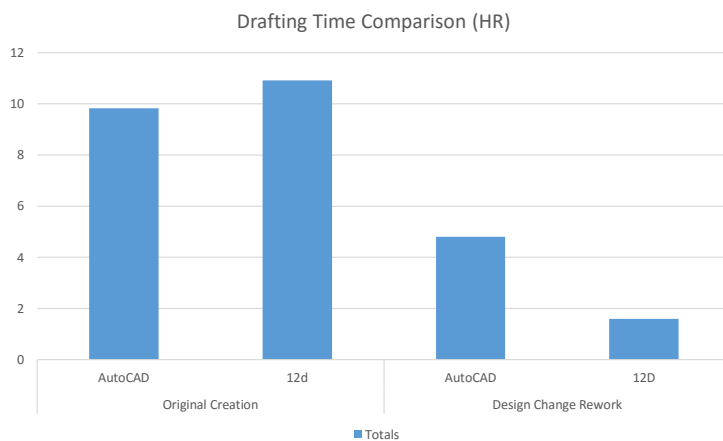
Design Calculation Automation

- Automate Calculations and design checks
- Reduce Human input



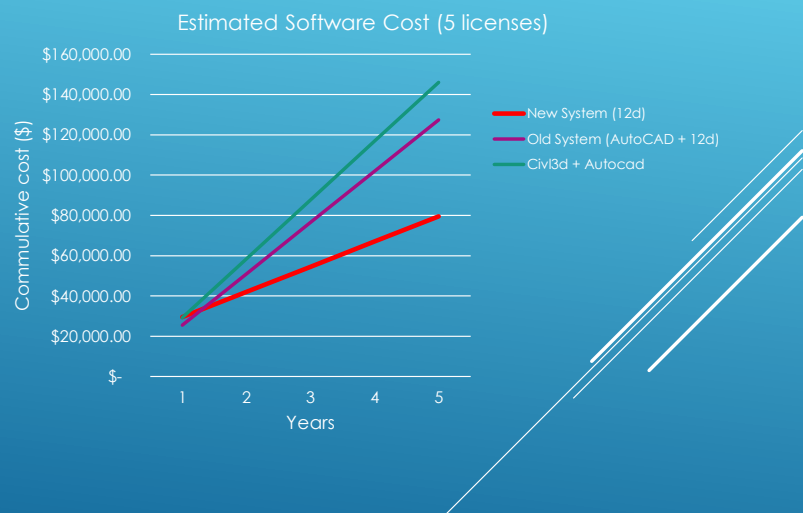
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Results – Productivity



RESULTS – PROJECT COST AND POTENTIAL SAVINGS

- \$74,000 Saving in software costs over 5 years
 - Ignores
 - Productivity increases
 - Increase in workforce
- Project Development and training – 340 Hours
- Project cost - \$17,000
- Program Prices - Per User Per Year
 - 12d - \$2,500
 - AutoCAD - \$2,596
 - Civil3d - \$3,245





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RESULTS – PRODUCTIVITY & OVERALL SAVINGS

Productivity improvement savings per year

AutoCAD		12d	
Estimated Time (HRs)	Estimated Cost	Estimated Time (HRs)	Estimated Cost
19991	\$ 999,546	18588	\$ 929,405



DISCUSSION/ CONCLUSIONS

- ▶ Further development required
- ▶ Further training required
- ▶ Project has potential



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12d Plot Manager

PPF	Plan Title 1	Plan Title 2	Plan Title 3	Plan Title 4	Plan Title 5	Client Information 1	Client Information 2	Client Information 3
1 DETAIL 01.plotframeppf						Client		
2 DETAIL 03.plotframeppf						Client		
3 DETAIL 02.plotframeppf						Client		



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Report Title: 12d Plot Manager

Project: Internal – 12d User Manual

Document Number: 92632

Document Register

Issue	Details of Change	Prepared	Reviewed	Date
A	Draft Issue for Review	DW		04/08/15
B	Added information on chains	DW		27/11/15

Known Bugs

Details of Bug	Found By	Fixed By
If sheet set selected but no rows endless loop created when plot pressed	DW	

Feature Requests

Details of Request	Requested By	Added By
Remove Delete Sheet from macro place in separate panel of its own.	DW	
Remove PPF from bulk edit drop down list	DW	



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2 Description

This panel has been developed to provide an accurate and simple method for managing all plotting and plot related data within 12d projects.

With PCB moving towards using 12d for all forms of drafting and presentation, a user friendly interface is necessary to assist drafting and design users to prepare the highest quality presentation drawings to showcase our skill as professionals.

This panel's use is to modify and plot drawings to PDF.

The panel is found in 12d menu under User→Drafting→Plot Manager.

3 Panel Use

The panel is prefilled with all drawings currently in the project and cells are populated with current data.

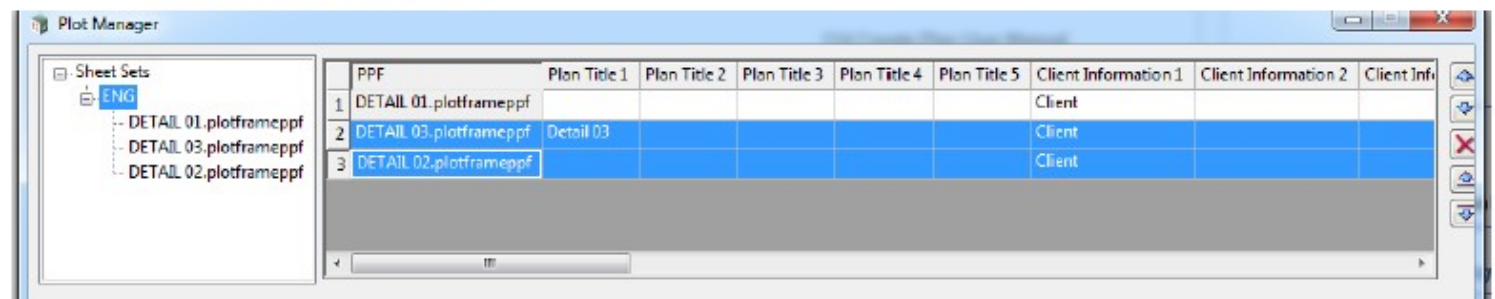
3.1 Important Information

PDFCreator must be installed to allow the plotting to PDF function of this Macro to work. It can be found in the software library or the latest version can be downloaded here;

<http://www.pdfforge.org/pdfcreator/download>

There are multiple ways to select plans in order to plot or modify;

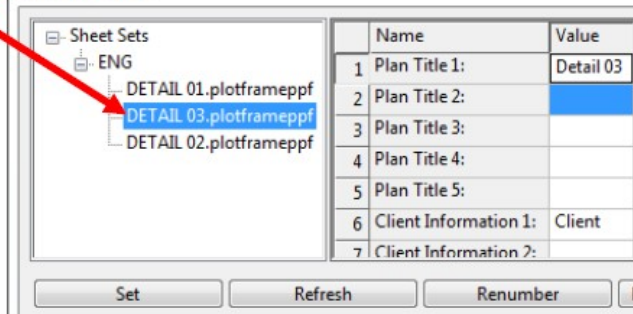
- Highlight them in the table



Sheet detail 03 and detail 02 is selected

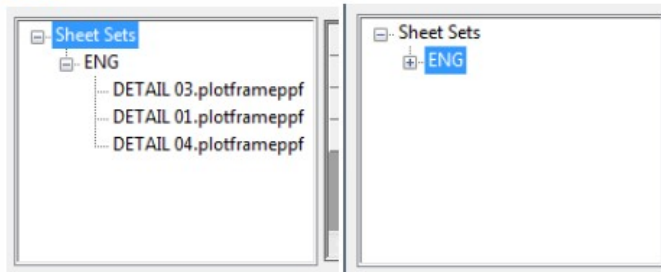
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- Select a single Plan in the tree.



Sheet detail 03 is selected

3.2 Sheet Set Tree



The Sheet Set Tree contains all sheets within the project separated into their sheet sets

If a sheet set (Eg. ENG) or a plan (Eg. Detail 03.plotframeppf) is selected the data in the table to the right of the tree is updated.

Each sheet set can be collapsed or expanded by pressing the + or – buttons within the tree.

3.3 Table

PPF	Plan Title 1	Plan Title 2	Plan Title 3	Plan Title 4	Plan Title 5	Client Information 1	Client Information 2	Client Information 3
1 DETAIL 03.plotframeppf								
2 DETAIL 01.plotframeppf								
3 DETAIL 04.plotframeppf								

Rev#5	Rev Desc5	Rev by5	Rev Date5	Rev#6	Rev Desc6	Rev by6	Rev Date6	FileID	Total Sheets	Sheet Number	Year	Sheet Set
1									3	1	2015	ENG
2									3	2	2015	ENG
3									3	3	2015	ENG

Above is an example of the table when a sheet set is selected in the tree

Below is an example of table when a single sheet is selected in the tree

Name	Value
1 Plan Title 1:	
2 Plan Title 2:	
3 Plan Title 3:	
4 Plan Title 4:	
5 Plan Title 5:	
6 Client Information 1:	
7 Client Information 2:	

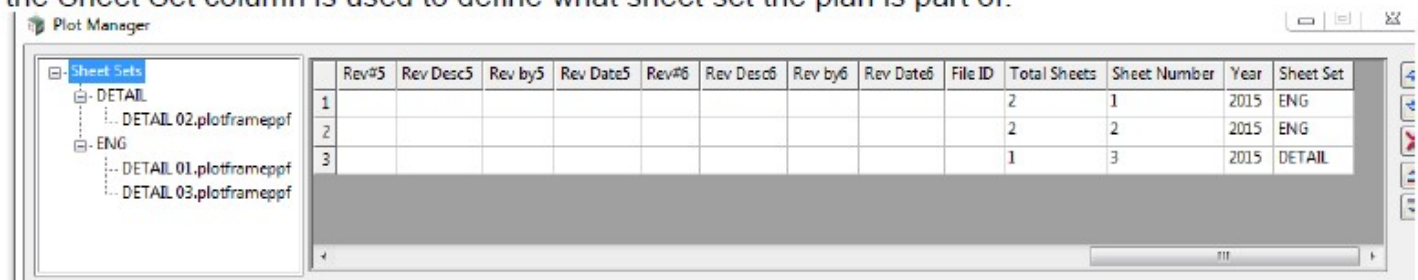


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The Table layout and contents varies depending on the current tree selection (as above).

If a sheet set is selected

All columns refer to a specific item on the plan with the exception of the “Sheet Set” column the Sheet Set column is used to define what sheet set the plan is part of.



Rev#5	Rev Desc5	Rev by5	Rev Date5	Rev#6	Rev Desc6	Rev by6	Rev Date6	File ID	Total Sheets	Sheet Number	Year	Sheet Set
1									2	1	2015	ENG
2									2	2	2015	ENG
3									1	3	2015	DETAIL

The sheet order can be changed by using the arrows to the right of the table. The sheets can be renumbered using the renumber button (Refer to 3.6.3).



If the user selects one or multiple rows then the selected sheets can be plotted to either a PDF or to a model. (Refer to 3.6)

If the current selection is a plan view the user can also open or close the selected plans. (Refer to 3.6)

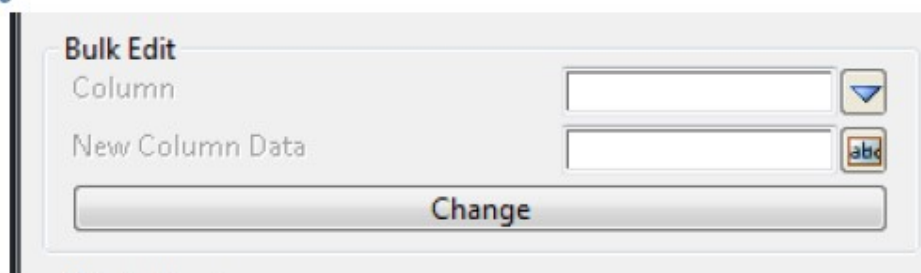
If you wish to modify an entire column of the table the bulk edit section of the macro can be used. (Refer to 3.4)

If a single sheet is selected all options work similar to above but all settings will only be related to that single sheet.


To save changes the set button must be pressed otherwise all changes will be lost.


To revert to the last saved version of the table press the refresh button.

3.4 Bulk Edit



Bulk Edit

Column 

New Column Data 

The bulk edit section of the macro allows editing of entire columns of the current active table.



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Firstly select a column from the drop down box and insert the required data into the New Column Data field. Press the change button and that entire column of the table will be populated with the new data.

If the user is satisfied with the changes the set button must be pressed to save all changes.

Example of Bulk Edit.

As the client name will be the same for all sheets instead of entering them individually one by one the bulk edit function can be used to modify the client name for all sheets in the table.

The table below currently has nothing entered into the client information column

	PPF	Plan Title 1	Plan Title 2	Plan Title 3	Plan Title 4	Plan Title 5	Client Information 1	Client Information 2
1	DETAIL 03.plotframeppf	Detail 03						
2	DETAIL 01.plotframeppf							
3	DETAIL 02.plotframeppf							

In the bulk edit part of the panel select "Client Information" for the column and enter what you want the cell populated with in the next field. Press Change

Edits

Bulk Edit

Column

Client Information 1

New Column Data

CLIENT NAME

Change

As per below the entire "Client Information" column has now been populated with CLIENT NAME.

	PPF	Plan Title 1	Plan Title 2	Plan Title 3	Plan Title 4	Plan Title 5	Client Information 1	Client Information 2
1	DETAIL 03.plotframeppf	Detail 03					CLIENT NAME	
2	DETAIL 01.plotframeppf						CLIENT NAME	
3	DETAIL 02.plotframeppf						CLIENT NAME	

If you are then satisfied with the changes hit the set button to save them or refresh to revert to previously saved settings.

3.5 Delete

Delete Sheet

Plot Files

Delete

IMPORTANT; The Delete Section of the panel should only be used if you want to completely remove all traces of the sheet. Eg. Created a plan by mistake.

NOTE; If you want to remove a sheet from a sheet set. Remove or change the information in the sheets "Sheet Set" column of the table and hit set.

Example – Remove Sheet from sheet set.

Name	Value
39 Revision Date:	
40 File_ID:	
41 Total Sheets:	2
42 Sheet #:	2
43 Year:	2015
44 Sheet Set	ENG

Delete the value in the Sheet Set row of the sheets data then hit set.

As you can see below the sheet is no longer contained within the sheet set.

PPF	
1	DETAIL 01.plotframeppf
2	DETAIL 03.plotframeppf
3	DETAIL 02.plotframeppf



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3.6 Buttons

3.6.1 Set

When pressed the Set button saves all current settings in the macro back to the plan files

3.6.2 Refresh

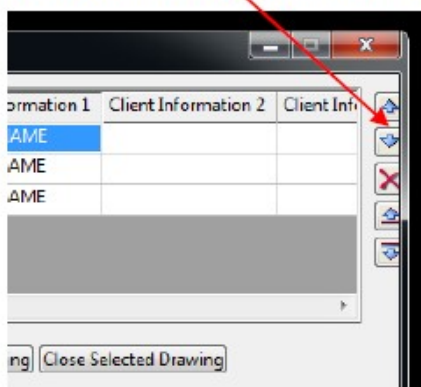
Should be used if you want to revert back to the last saved settings.

3.6.3 Renumber

Renumbers all the plans in the current table. The set button must then be pressed to save this

The Renumber button uses an increment of 1, starting at 1 for item 1 of the table, 2 for item 2 of the table etc.

For renumber to make a change in sheet numbers you must first rearrange the sheets using the arrows to the right of the table.



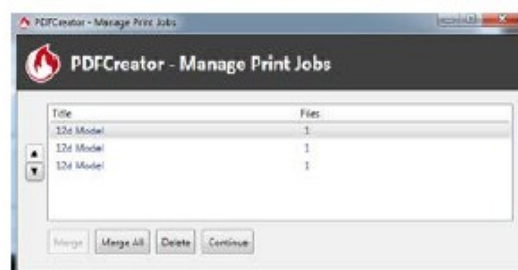
3.6.4 Plot Selected To PDF

Plots Selected plans to PDF



Once the button is pressed the program will then make a backup of all data being plotted and the panel to the left will appear.

On this panel click the merge button.



The above panel will appear on your screen. Press "Merge All" then "Continue".

You will then be taken back to the panel on the left.

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From this panel first choose a profile. This determines the format to save to. Eg. PDF, TIFF.



Save the plotted drawings by hitting save and then choose the desired directory.

Further information about Pdf Creator can be found in its manual.

<http://www.pdfforge.org/pdfcreator/manual>

3.6.5 Plot Selected to Model

Same as above but plots to a 12d model to temporarily view the data.

3.6.6 Open Selected Drawing

Opens the model space and paper space views including all used models for the selected plans. (See [Create Plan Manual](#) for Information on Model and Paper Space Views)

3.6.7 Close Selected Drawing

Closes the model space and paper space views including all used models for the selected plans. (See [Create Plan Manual](#) for Information on Model and Paper Space Views)

3.7 Chain functionality

A chain will automatically run prior to plotting the plan when the chain has the same name as the PPF and is contained within the jobs 12d directory. Eg:

```
../DRAFTING.project/SET OUT 01.plotframeppf
```

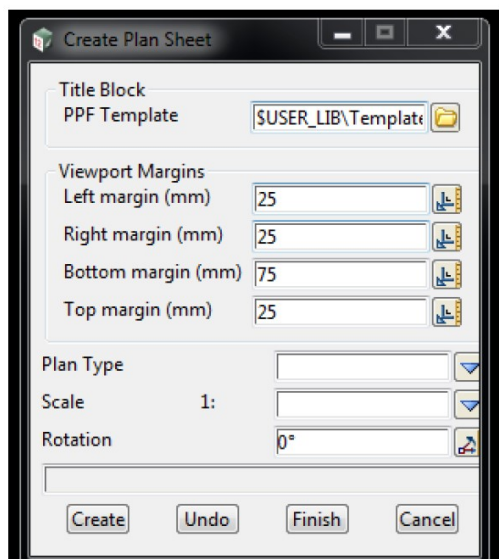
```
../SET OUT 01.chain
```

NOTE: the plan ppf plot should not be included in the chain. This is plotted after the chain is run.



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12d Create Plan Panel



Report Title:	12d Plot Manager
Project:	Internal – 12d User Manual
Document Number:	92975

Document Register

Issue	Details of Change	Prepared	Reviewed	Date
A	Draft Issue for Review	DW		08/08/15

Known Bugs

Details of Bug	Found By	Fixed By

Feature Requests

Details of Request	Requested By	Added By

2 Description

This panel has been developed to provide an accurate and simple method for managing all plotting and plot related data within 12d projects.

With PCB moving towards using 12d for all forms of drafting and presentation, a user friendly interface is necessary to assist drafting and design users to prepare the highest quality presentation drawings to showcase our skill as professionals.

This panel's use is to create all required data for a new drawing (Plan View) in 12d

The panel is found in 12d menu under User→Drafting→Create Plan Sheet.

3 Panel Use

Use of this panel is very simple. Firstly fill out required data on the panel

Press the create button

Left click in a view and the view port frame will appear

When happy with the location of the viewport

Left click then middle mouse button to accept the position

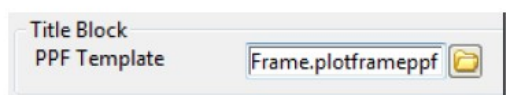
Two views will then be created (Model Space and Paper Space)

As well as the plans PPF file.

3.1 Important Information

If creating a new PPF template. Use the Template_Plot_Frame.plotframeppf as a guide.

3.2 Title Block & Drawing Template



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Select the Drawing template you desire. Similar to AutoCAD's Template Drawings.

This chooses the size of the drawing and title block style.

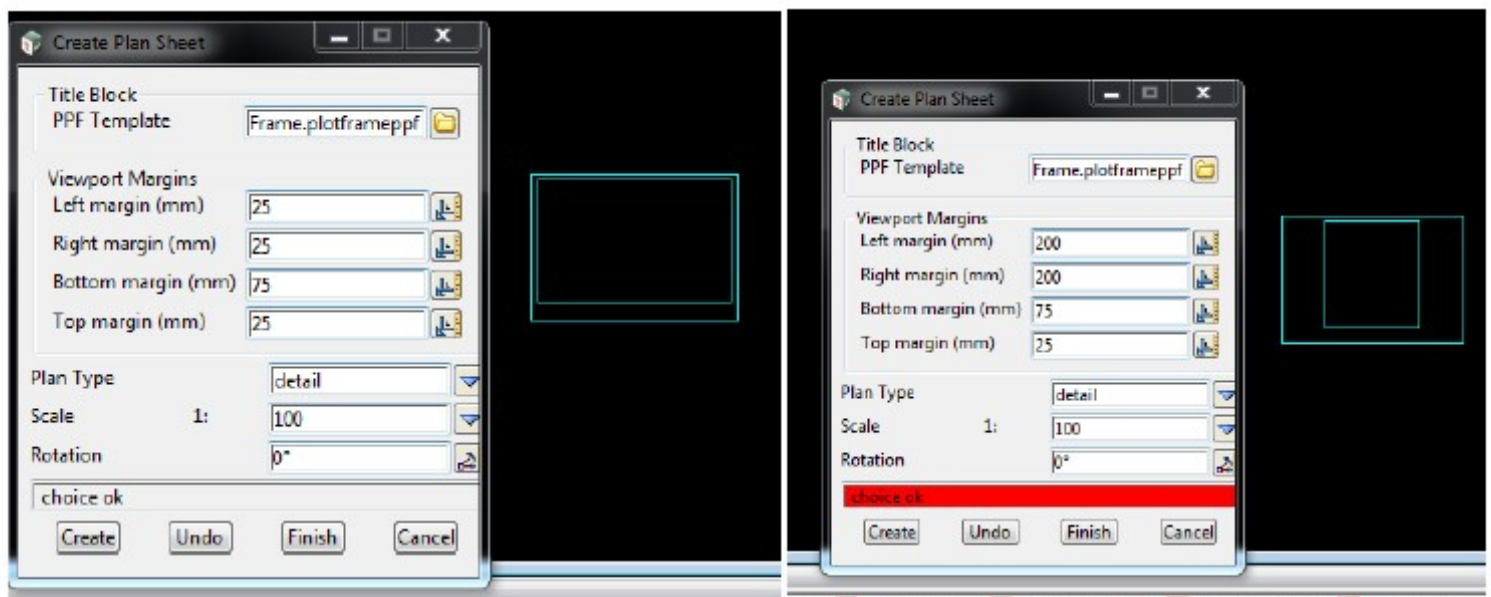
3.3 Viewport Margins

Viewport Margins	
Left margin (mm)	25
Right margin (mm)	25
Bottom margin (mm)	75
Top margin (mm)	25

The user may wish to decrease the viewport size, if there is information the user wishes to hide on the plan e.g. Survey data or lot boundaries outside of the scope of works may clutter the plan and can be hidden by reducing the viewport size (increasing margins).

Minimum margin sizes are set in the PPF template file.

Should the user wish to increase margins to reduce viewport size modify these numbers, the changes update dynamically and are seen visually on the screen.



The above screenshots shows an example of changing view port extents.

Model space information will only plot within in inner cyan line

The outer cyan line shows the extent of the sheet.

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3.4 Plan Type



Select from the drop down list a plan type that best relates to what your creating
This sets the name of all views and PPF files. This is a generalised name to help distinguish between plans.

Plan Types

- DETAIL
- BOMA
- CATCHMENT
- COMMUNICATIONS
- COMMUNITY
- CONSTRUCTION
- EARTHWORKS
- EASEMENT
- ELECTRICAL
- EROSION
- FLOOR
- GAS
- GENERAL ARRANGEMENT
- IDENTIFICATION
- LANDSCAPE
- LOCAL ENVIROMENT
- LOCALITY
- SALES
- SET OUT
- SEWER
- SITE
- STORMWATER
- STRATA
- SUBDIVISION
- TYPICAL SECTION
- WATER

3.5 Scale



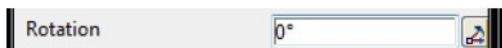
A pre-set list of Australian Standard scales can be seen in the drop down box.

Any change to your plans scale can be seen visually when you move the mouse back into the view.

Available Scales

1:10	1:300	1:1250
1:20	1:400	1:1500
1:25	1:500	1:2000
1:50	1:600	1:2500
1:100	1:700	1:3000
1:125	1:750	1:4000
1:150	1:800	1:5000
1:200	1:900	1:10000
1:250	1:1000	

3.6 Rotation



This allows the rotation of a viewport. This can be seen visually in a view once the angle is updated

NOTE: Where Possible keep rotation to 0. Text Rotated to match the view port is currently difficult to obtain and a macro needs to be written for this purpose.



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3.7 Buttons

3.7.1 Create

Once all the above fields are filled out. Use this button to create the viewport

Left click in a view and the view port frame will appear

When happy with the location of the viewport

Left click then middle mouse button to accept the position

3.7.2 Undo

Used to undo last created viewport.

3.7.3 Finish

Close Panel

4 Panel Output

4.1 Views

Once a plan is created and accepted using above manual options

Two views are created each plan requires two unique views.

4.1.1 Model Space View

The model space view has the name format MODEL "Plan Type" "UNIQUE NUMBER"

Any models turned on in model space that are within the viewport extents will be plotted to scale on the plan.

An easy comparison is this works exactly the same as AutoCAD's Model space

4.1.2 Paper Space View

The paper space view has the name format PAPER "Plan Type" "UNIQUE NUMBER"

12Ds Paper space works similarly to an AutoCAD layout tab but with some minor differences.

The Title Block and Model Space info shown in this view isn't Dynamic like AutoCAD and must be manually updated/replotted (Refer to USER→Drafting→Plot Manager ID 92632)

The Title Block and Model Space info is kept in a Junk Model called "Plot (Plan Type) (Unique Number)" this data should not be modified from within the Paper space Model and is purely for visualisation of the final plan.

To modify this data use either Model Space or the Plot Manager for title block information.

4.1.2.1 Add Paper Space Data

To add any data to paper space (e.g. a diagram)

The diagram should be drawn around the 0 0 coordinates in mm units.

On the layer "CAD PAPER (Plan Type)(Reference Number)" e.g. "CAD PAPER DETAIL 01"

NOTE: This model is created with the plans and is already turned on in the paper space view.