Dynamic Pattern Synthesis

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Wednesday, July 11th, 2018

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cecan
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DPS

University of Brighton

Social Media

@cecanexus

@profpdh

#complexity

#methods

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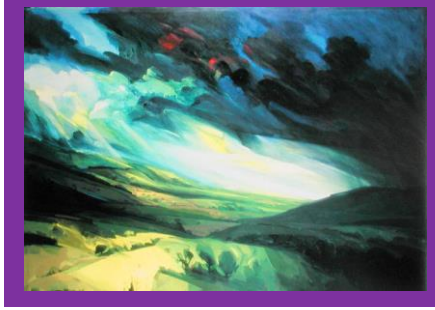

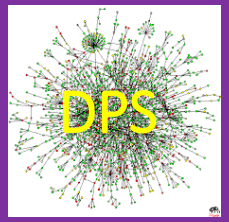

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Contingent Causality

- A + B = E
- C + D = E
- Different patterns give the same outcome
- A + B = E
- A + B = F
- The same patterns give different outcomes

Prof C. Ragin,
Univ. of California

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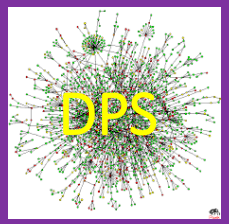
Social System dynamics

- Causality as changing interactions rather than stable mechanics
- Causality/interactions change in context (space, time)
- What degree of confidence in *partial* 'mechanisms'?
  - Need a broad view of influences



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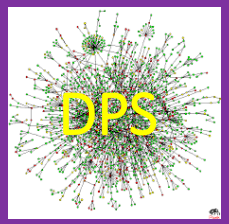
Method

How DPS works…



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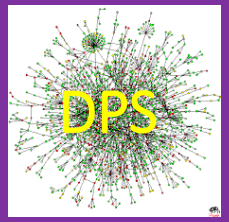
DPS: Design

Seeks to identify patterns in data sets

- Datasets maybe relatively simple
- Even a small matrix offers lots of potential patterns
- Small n
- Assumes complex interactions



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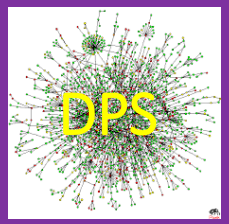
DPS Method: Qualitative or Quantitative?

- **Qualitative or Quantitative?**
- ***Small n***
- ***Exploratory***
- ***Exploring interactions***
- ***Over time***
- ***Using quantitative measures***
- ***To make robust qualitative decisions***



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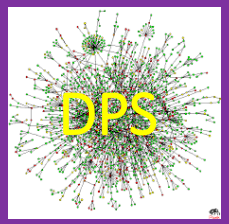
Starting DPS: Cluster Analysis

- Select a suitable number of comparable cases with a longitudinal dataset
  - scale variables
  - At least 3 time points
- If the dataset is n > 50, reduce to a logical number of sub samples and consider each separately



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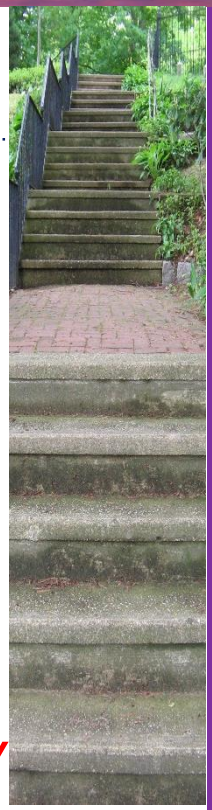
DPS: combines HCA with QCA

DPS: seven steps

1. *HCA with scale dataset*
2. *Hypothesize clusters*
3. *Test clusters with QCA*
4. *Theorise*
5. *Repeat over several time points*
6. *Theorise longitudinal patterns*
7. *Typology of stability and instability*



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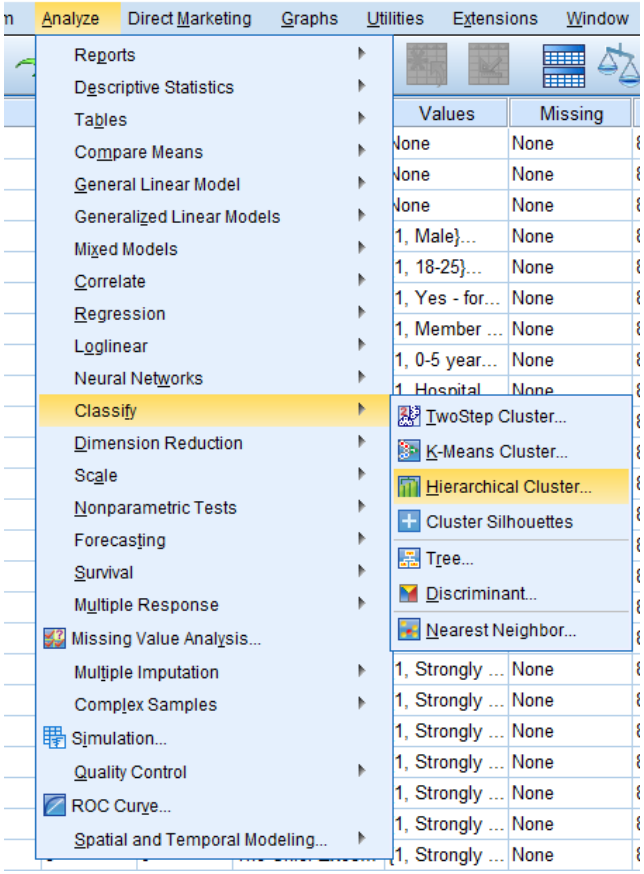
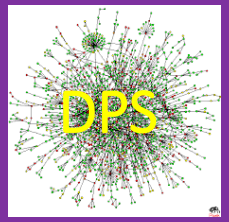
Hierarchical Cluster Analysis (HCA)

- HCA
  - No prior hypothesis about number of clusters
  - Exploratory
- Small n
- Agglomerative: assumes all cases are unique





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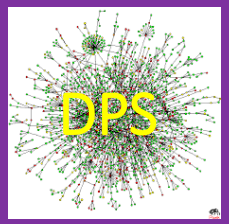
QCA: to examine clusters

Configurations of cases

Shows variable influences on different clusters of cases

Theorise patterns

Boolean algebra



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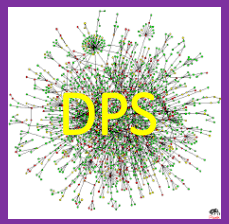
DPS: an example

Comparing organisation performance

Innovative, high tech, research



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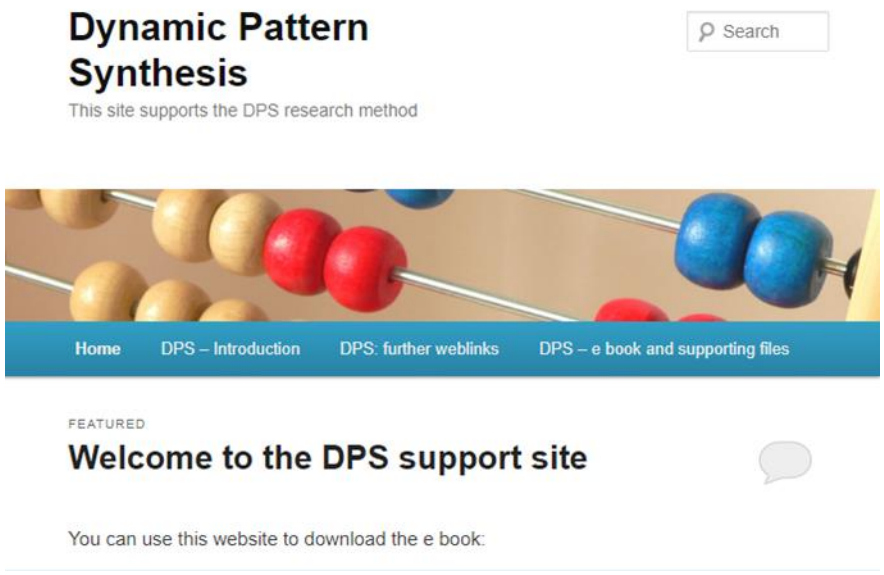
New open source: online resource

- Teach yourself DPS
- Then, teach your staff and/or students DPS
- Via: **http://blogs.brighton.ac.uk/dpsmethod/**



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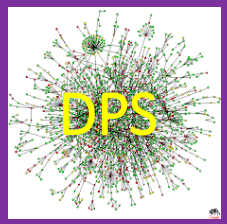
Level

- **Organisations**
- N=12
- 11 variables



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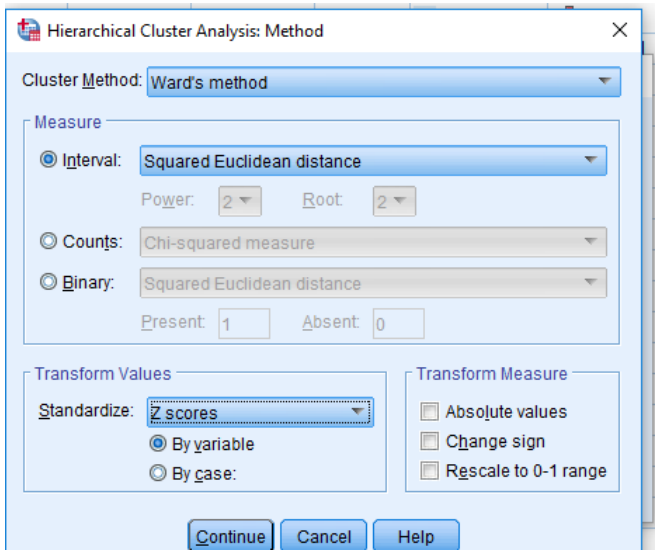
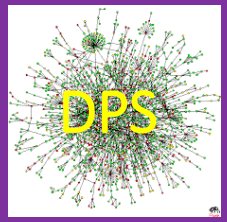
Cluster Analysis

HCA

- Use data to create hypothesis for n clusters
- Agglomerative HCA
- Ward's method (ESS)
- Standardise variables with z scores





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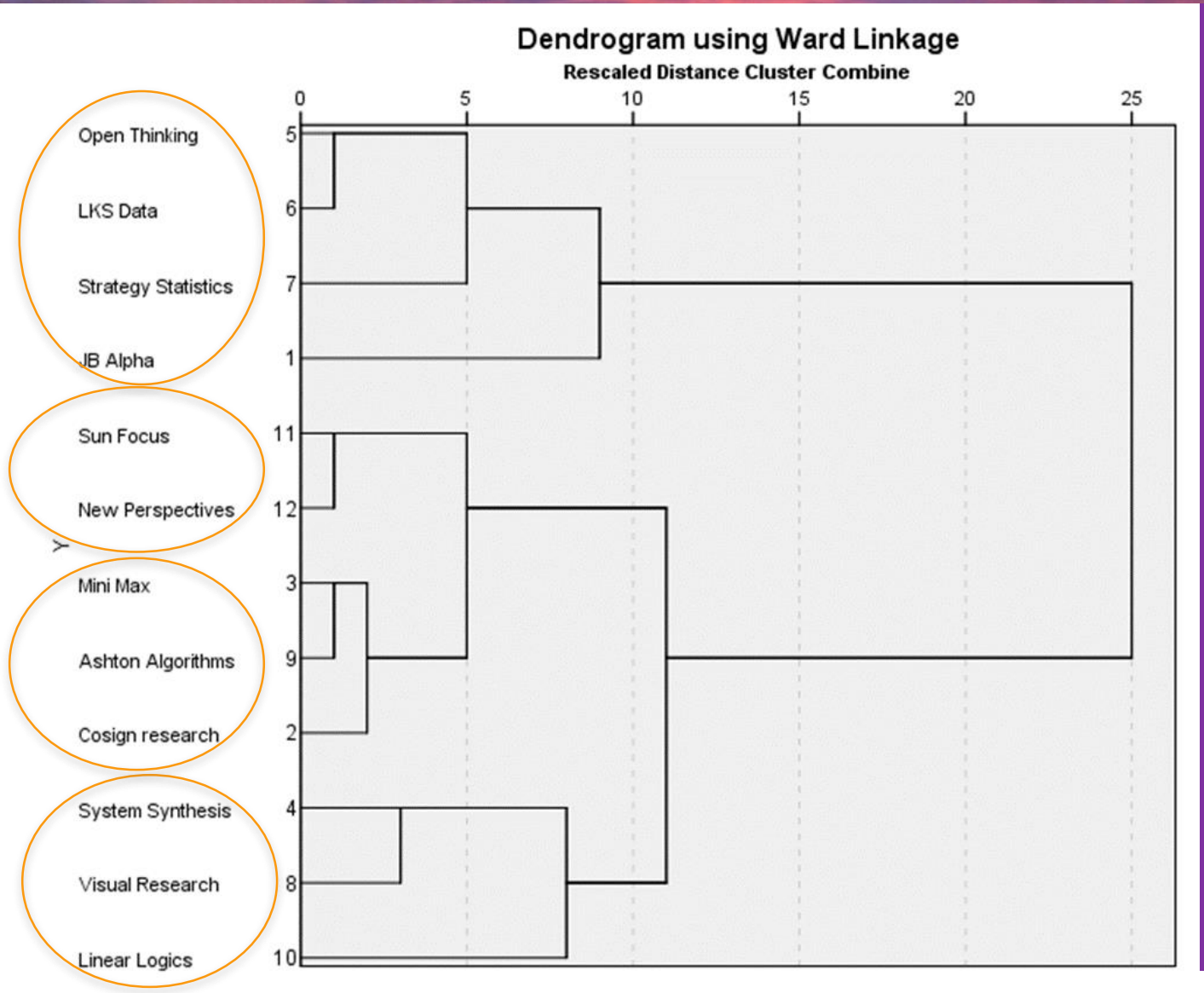
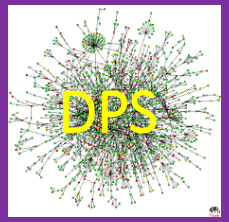
2015 data





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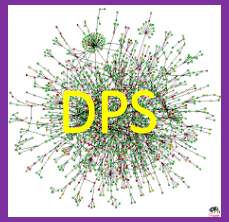
QCA cs – to examine variables interactions

- Convert the scale dataset to binary crisp set (1, 0)
- threshold points
  - With r*eference* to mean, median, standard dev
- Use QCA to test the hypothesis that n – clusters exist
- Plot QCA truth table to test hypothesis
- Validate clusters with prime implicants



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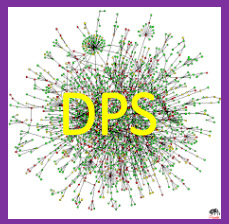
Setting up QCA 'truth table', 2015

Business Name	Capexpend2015	AnIncomeGrow2015	PercentWFwithPGT2015	Genderpaygap2015	Marketing2015	Managers2015	Overseas2015	continuecustomers2015	debtors2015	staffturnover2015	sicknessdays2015
JB Alpha	12.3	2.9	72.0	2.0	5.0	0.10	0.0	90.0	2.0	30.0	6.0
Cosign Research	11.1	3.0	54.0	3.0	4.3	0.03	6.0	84.0	2.0	15.0	4.0
Mini Max	4.5	4.0	32.0	3.0	5.2	0.02	0.0	86.0	3.0	16.0	7.0
System Synthesis	9.2	13.7	34.0	7.0	8.1	0.01	12.0	82.0	3.0	13.0	6.0
Open Thinking	8.7	15.6	67.0	1.0	4.2	0.05	6.0	100.0	0.5	16.0	5.0
LKS Data	3.1	8.9	76.0	1.0	4.0	0.05	5.0	98.0	1.0	8.0	4.0
Strategy Statistics	2.1	6.9	90.0	1.0	4.6	0.04	3.0	89.0	1.0	21.0	9.0
Visual Research	9.8	20.3	43.0	3.0	5.7	0.05	8.0	84.0	3.0	2.0	7.0
Ashton Algorithms	7.1	2.8	56.0	1.0	7.2	0.03	4.0	77.0	3.5	14.0	6.0
Linear Logics	7.4	2.3	42.0	8.0	6.1	0.05	23.0	76.0	3.0	9.0	3.0
Sun Focus	5.7	7.1	56.0	2.0	3.7	0.04	4.0	69.0	5.0	7.0	4.0
New Perspectives	4.7	7.3	45.0	4.0	2.3	0.04	11.0	80.0	3.0	11.0	6.0
Mean	*7.1*	*7.9*	*55.6*	*3.0*	*5.0*	*0.04*	*6.8*	*84.6*	*2.5*	*13.5*	*5.6*
Median	*7.3*	*7.0*	*55.0*	*2.5*	*4.8*	*0.04*	*5.5*	*84.0*	*3.0*	*13.5*	*6.0*
Standard Deviation	*3.1*	*5.6*	*17.0*	*2.2*	*1.5*	*0.02*	*6.0*	*8.5*	*1.2*	*6.9*	*1.6*
JB Alpha	1	0	1	0	1	1	0	1	0	1	1
Cosign Research	1	0	0	1	0	0	1	1	0	1	0
Mini Max	0	0	0	1	1	0	0	1	1	1	1
System Synthesis	1	1	0	1	1	0	1	0	1	0	1
Open Thinking	1	1	1	0	0	1	1	1	0	1	0
LKS Data	0	1	1	0	0	1	0	1	0	0	0
Strategy Statistics	0	0	1	0	0	1	0	1	0	1	1
Visual Research	1	1	0	1	1	1	1	1	1	0	1
Ashton Algorithms	0	0	1	0	1	0	0	0	1	1	1
Linear Logics	1	0	0	1	1	1	1	0	1	0	0
Sun Focus	0	1	1	0	0	1	0	0	1	0	0
New Perspectives	0	1	0	1	0	1	1	0	1	0	1



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Mini Max	4.5	4.0	32.0	3.0	5.2	0.02	0.0	86.0	3.0	16.0	7.0
System Synthesis	9.2	13.7	34.0	7.0	8.1	0.01	12.0	82.0	3.0	13.0	6.0
Open Thinking	8.7	15.6	67.0	1.0	4.2	0.05	6.0	100.0	0.5	16.0	5.0
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Strategy Statistics	2.1	6.9	90.0	1.0	4.6	0.04	3.0	89.0	1.0	21.0	9.0
Visual Research	9.8	20.3	43.0	3.0	5.7	0.05	8.0	84.0	3.0	2.0	7.0
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Sun Focus	5.7	7.1	56.0	2.0	3.7	0.04	4.0	69.0	5.0	7.0	4.0
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Mean	*7.1*	*7.9*	*55.6*	*3.0*	*5.0*	*0.04*	*6.8*	*84.6*	*2.5*	*13.5*	*5.6*
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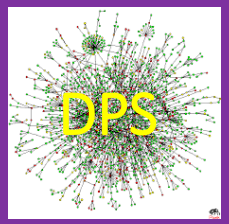
Standard Deviation	*3.1*	*5.6*	*17.0*	*2.2*	*1.5*	*0.02*	*6.0*	*8.5*	*1.2*	*6.9*	*1.6*
JB Alpha	1	0	1	0	1	1	0	1	0	1	1
Cosign Research	1	0	0	1	0	0	1	1	0	1	0
Mini Max	0	0	0	1	1	0	0	1	1	1	1
System Synthesis	1	1	0	1	1	0	1	0	1	0	1
Open Thinking	1	1	1	0	0	1	1	1	0	1	0
LKS Data	0	1	1	0	0	1	0	1	0	0	0
Strategy Statistics	0	0	1	0	0	1	0	1	0	1	1
Visual Research	1	1	0	1	1	1	1	1	1	0	1
Ashton Algorithms	0	0	1	0	1	0	0	0	1	1	1
Linear Logics	1	0	0	1	1	1	1	0	1	0	0
Sun Focus	0	1	1	0	0	1	0	0	1	0	0
New Perspectives	0	1	0	1	0	1	1	0	1	0	1

Threshold setting, cluster 1, 2015

Percentage of annual exp. on capital investment

Median = 7.3
Mean = 7.1
St Dev = 3.1

	CA score	QCA score
Strategy Statistics	2.1	0
LKS Data	3.1	0
JB Alpha	12.3	1
Open Thinking	8.7	1



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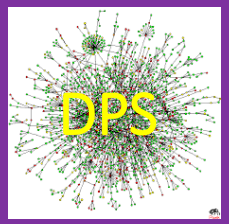
QCA: Prime Implicants

- **Prime Implicants**
- All cases in a cluster
- Share same variable threshold



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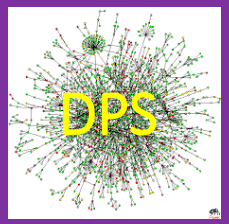
QCA Truth Table, with cluster outcomes: 2015

	Capexpend2015	AnIncomeGrow2015	PercentWFwithPGT2015	Genderpaygap2015	Marketing2015	Managers2015	Overseas2015	continuecustomers2015	debtors2015	staffturnover2015	sicknessdays2015	cluster
Strategy Statistics	0	0	**1**	**0**	0	**1**	0	**1**	**0**	1	1	1
LKS Data	0	1	**1**	**0**	0	**1**	0	**1**	**0**	0	0	1
JB Alpha	1	0	**1**	**0**	1	**1**	0	**1**	**0**	1	1	1
Open Thinking	1	1	**1**	**0**	0	**1**	1	**1**	**0**	1	0	1
New Perspectives	**0**	**1**	0	1	**0**	**1**	1	**0**	**1**	**0**	1	2
Sun Focus	**0**	**1**	1	0	**0**	**1**	0	**0**	**1**	**0**	0	2
Mini Max	0	**0**	0	1	1	**0**	0	1	1	**1**	1	3
Ashton Algorithms	0	**0**	1	0	1	**0**	0	0	1	**1**	1	3
Cosign Research	1	**0**	0	1	0	**0**	1	1	0	**1**	0	3
Linear Logics	**1**	0	**0**	**1**	**1**	1	**1**	0	**1**	**0**	0	4
System Synthesis	**1**	1	**0**	**1**	**1**	0	**1**	0	**1**	**0**	1	4
Visual Research	**1**	1	**0**	**1**	**1**	1	**1**	1	**1**	**0**	1	4



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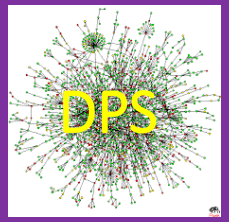
QCA Prime Implicants, cluster 1: 2015

	Capexpend2015	AnIncomeGrow2015	PercentWFwithPGT2015	Genderpaygap2015	Marketing2015	Managers2015	Overseas2015	continuecustomers2015	debtors2015	staffturnover2015	sicknessdays2015	cluster
Strategy Statistics	0	0	**1**	**0**	0	**1**	0	**1**	**0**	1	1	1
LKS Data	0	1	**1**	**0**	0	**1**	0	**1**	**0**	0	0	1
JB Alpha	1	0	**1**	**0**	1	**1**	0	**1**	**0**	1	1	1
Open Thinking	1	1	**1**	**0**	0	**1**	1	**1**	**0**	1	0	1



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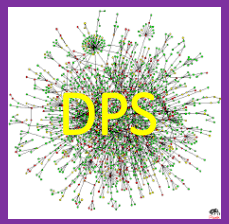
Boolean simplification:2015

Cluster 1:

PGT * genderpay * MANAGERS * CONTINUING * debtors



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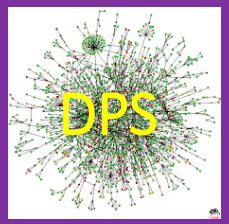
Realigning table: to show an outcome

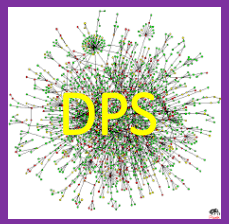
	Capexpend2015	AnIncomeGrow2015	PercentWFwithPGT2015	Genderpaygap2015	Marketing2015	Managers2015	Overseas2015	Continuecustomers2015	Staffturnover2015	Sicknessdays2015	Cluster	Debtors2015
Strategy Statistics	0	0	1	0	0	1	0	**1**	1	1	1	0
LKS Data	0	1	1	0	0	1	0	**1**	0	0	1	0
JB Alpha	1	0	1	0	1	1	0	**1**	1	1	1	0
Open Thinking	1	1	1	0	0	1	1	**1**	1	0	1	0
Cosign Research	1	0	0	1	0	0	1	**1**	1	0	2	0
Mini Max	0	0	0	1	1	0	0	1	1	1	2	1
Ashton Algorithms	0	0	1	0	1	0	0	0	1	1	2	1
New Perspectives	0	1	0	1	0	1	1	0	0	1	3	1
Sun Focus	0	1	1	0	0	1	0	0	0	0	3	1
Linear Logics	1	0	0	1	1	1	1	0	0	0	4	1
System Synthesis	1	1	0	1	1	0	1	0	0	1	4	1
Visual Research	1	1	0	1	1	1	1	1	0	1	4	1



Boolean simplification:outcome 2015

For cluster 1, we can conclude with the Boolean simplification statement:

CONTINUING * MANAGERS * genderpay * PGT = debtors



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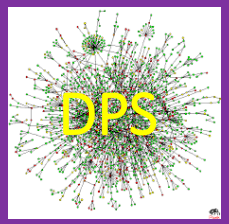
Repeat DPS for each time point

- 2015
- 2016
- 2017



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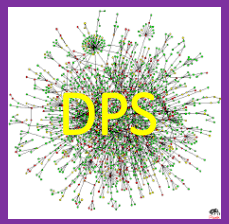
Final DPS

- Consider the nature of dynamic change over the time period.

1. Compare all cluster dendrograms
2. Plot longitudinal truth table (cluster stability)
3. Plot variable longitudinal averages (variable stability)

- CONCLUDE/theorise



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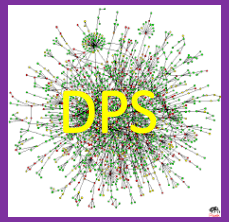
Cluster Change over time 2002-2013

Variable change, all cases, 2015-2017

	Capexpend2015	AnIncomeGrow2015	PercentWFwithPGT2015	Genderpaygap2015	Marketing2015	Managers2015	Overseas2015	continuecustomers2015	debtors2015	staffturnover2015	sicknessdays2015
2015	7.1	7.9	55.6	3.0	5.0	0.04	6.8	84.6	2.5	13.5	5.6
2016	7.8	3.4	58.7	2.5	5.8	0.04	6.8	86.8	2.4	7.6	4.8
2017	8.0	5.8	60.6	3.3	5.7	0.04	6.9	89.0	3.1	8.8	5.8
	stable	v	^	stable	stable	stable	stable	^	stable	v	stable



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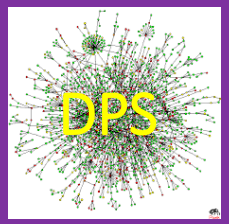
Case and cluster stability: 2015-2017

	Capexpend	AnIncomeGrow	PGT	Genderpaygap	Marketing	Managers	Overseas	Continuecustomers	Debtors	Stafftumover	Sicknessdays
Ashton Algorithms		BELOW	ABOVE		ABOVE	BELOW	BELOW	BELOW	ABOVE		
Open Thinking	ABOVE		ABOVE	BELOW		ABOVE	ABOVE	ABOVE	BELOW		
JB Alpha	ABOVE	BELOW	ABOVE	BELOW		ABOVE	BELOW	ABOVE	BELOW	ABOVE	
Sun Focus	BELOW		ABOVE					BELOW	ABOVE	BELOW	
LKS Data	BELOW		ABOVE	BELOW	BELOW		BELOW	ABOVE	BELOW	BELOW	BELOW
Strategy Statistics	BELOW		ABOVE	BELOW	BELOW	ABOVE	BELOW	ABOVE		ABOVE	
Linear Logics		BELOW	BELOW	ABOVE	ABOVE	ABOVE	ABOVE			BELOW	BELOW
System Synthesis			BELOW	ABOVE	ABOVE	BELOW	ABOVE	BELOW	ABOVE	BELOW	
Visual Research	ABOVE		BELOW	ABOVE					ABOVE	BELOW	ABOVE
Cosign Research	ABOVE		BELOW		BELOW	BELOW		ABOVE	BELOW		BELOW
New Perspectives	BELOW	ABOVE	BELOW	ABOVE	BELOW		ABOVE	BELOW			ABOVE
Mini Max	BELOW		BELOW			BELOW	BELOW				



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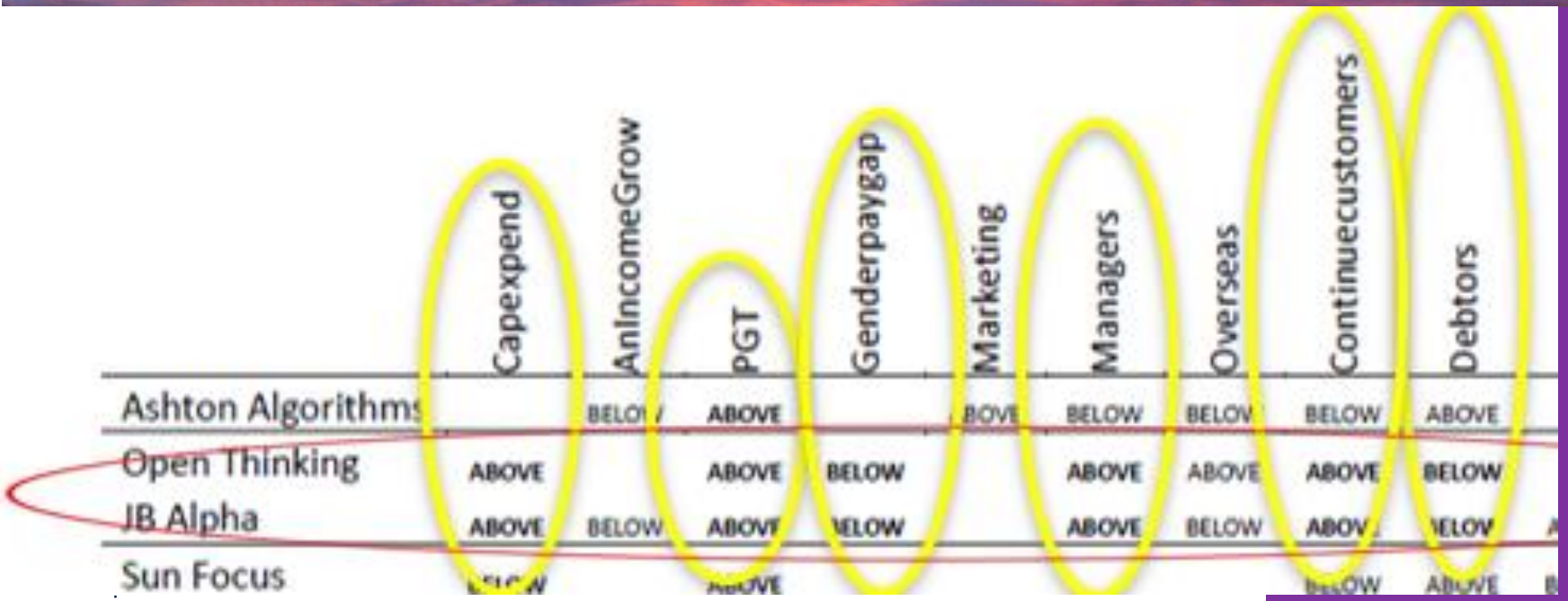
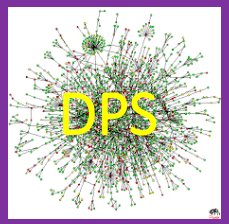
Longitudinal patterns: 2015-17
Case and cluster stability





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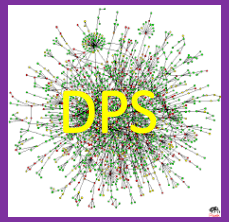
Longitudinal outcome view: 2015-2017

	Capexpend	AnIncomeGrow	PGT	Genderpaygap	Marketing	Managers	Overseas	Continuecustomers	Stafftumover	Sicknessdays	Debtors
Linear Logics		BELOW	BELOW	ABOVE	ABOVE	ABOVE	ABOVE		BELOW	BELOW	
Strategy Statistics	BELOW		ABOVE	BELOW	BELOW	ABOVE	BELOW	ABOVE	ABOVE		
Mini Max	BELOW		BELOW			BELOW	BELOW				
New Perspectives	BELOW	ABOVE	BELOW	ABOVE	BELOW		ABOVE	BELOW		ABOVE	
System Synthesis			BELOW	ABOVE	ABOVE	BELOW	ABOVE	BELOW	BELOW		ABOVE
Ashton Algorithms		BELOW	ABOVE		ABOVE	BELOW	BELOW	BELOW			ABOVE
Visual Research	ABOVE		BELOW	ABOVE					BELOW	ABOVE	ABOVE
Sun Focus	BELOW		ABOVE					BELOW	BELOW		ABOVE
Open Thinking	ABOVE		ABOVE	BELOW		ABOVE	ABOVE	ABOVE			BELOW
Cosign Research	ABOVE		BELOW		BELOW	BELOW		ABOVE		BELOW	BELOW
JB Alpha	ABOVE	BELOW	ABOVE	BELOW		ABOVE	BELOW	ABOVE	ABOVE		BELOW
LKS Data	BELOW		ABOVE	BELOW	BELOW		BELOW	ABOVE	BELOW	BELOW	BELOW



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Conclusion

- DPS
- Looks for consistent patterns over time in a small sample of cases
- It evidences similar cases and the reasons for similarity
- Patterns can be expressed as outcome related, if required.
- Future purposive sampling can be used to replicate findings and build up further evidence.
- Probability - Cochrane’s Q can be used to test whether change over time is expected or not in the outcome variable.

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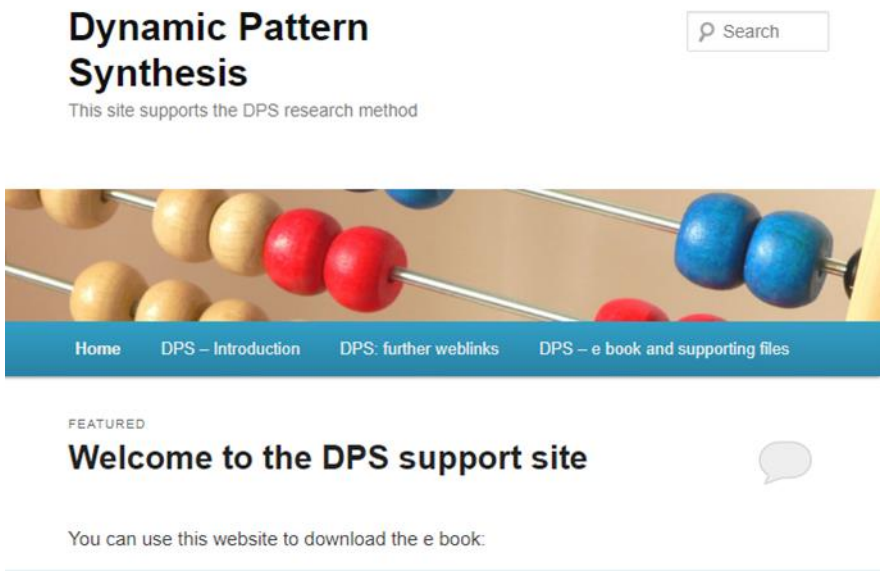
Type of system dynamics	*Variable Pattern*	*Case Pattern*	*Nature of Dynamic*
Stable dynamics	Stable	Stable	Cases stay in same clusters. Variable trends stable
Case instability	Stable	Unstable	Most cases change cluster. Variable trends are stable.
Cluster resilience (variable instability)	Unstable	Stable	Despite variable instability, Most cases stay in the same clusters.
System instability	Unstable	Unstable	Cases change cluster membership Variable trends are unstable

Source: Haynes, P (2017) *Social Synthesis: Finding Dynamic Patterns in Complex Social Systems* Oxon: Routledge ISBN 9781138208728

New open source: online resource

- Teach yourself DPS
- Then, teach your staff and/or students DPS
- Via: **http://blogs.brighton.ac.uk/dpsmethod/**



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