Performance Management Framework for Pavement Assets

Dr Kieran Feighan,
Chartered Engineer,
PMS Pavement Management Services Ltd.

24/09/15

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Transportation Asset Management

Different Way of Doing Business

- ❑ Increase service life
- ❑ Improve performance
- ❑ Preserve asset value
- ❑ Reduce annualized costs

Change The Way Assets Are Managed

Tell Your Story More Effectively

- ❑ Document needs
- ❑ Improve accountability in decisions
- ❑ Assess and manage risk
- ❑ Make better use of technology
- ❑ Better respond to changes in standards

Principles of Asset Management

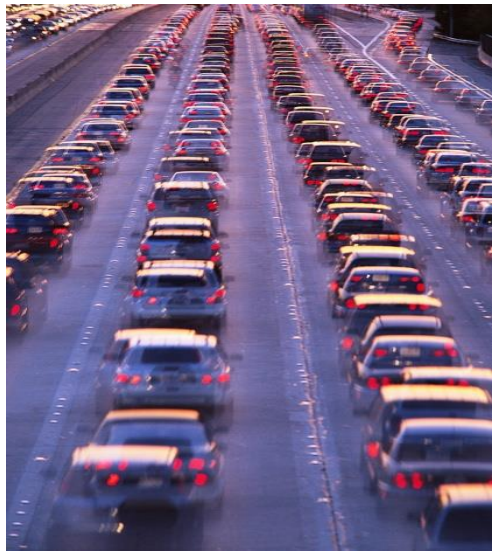
1. Policy driven
2. Performance based
3. Option oriented
4. Data driven
5. Transparent

Factors influencing decisions are known

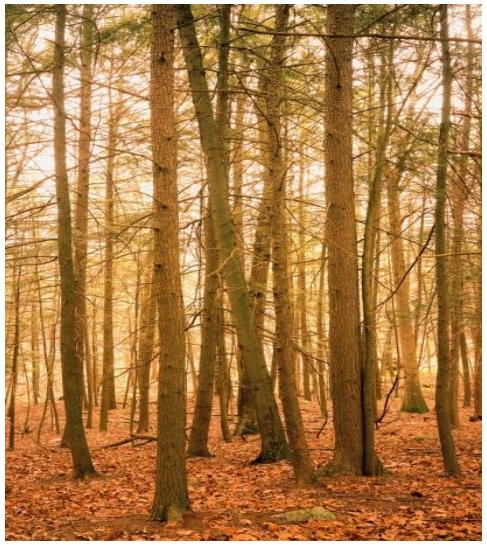
Key Performance Measures (or Indicators)

Physical Condition

Safety



Congestion



Environment

SMART Method of Evaluating Measures

- **S**pecific
- **M**easurable
- **A**chievable
- **R**esults Oriented
- **T**imely

Performance Targets

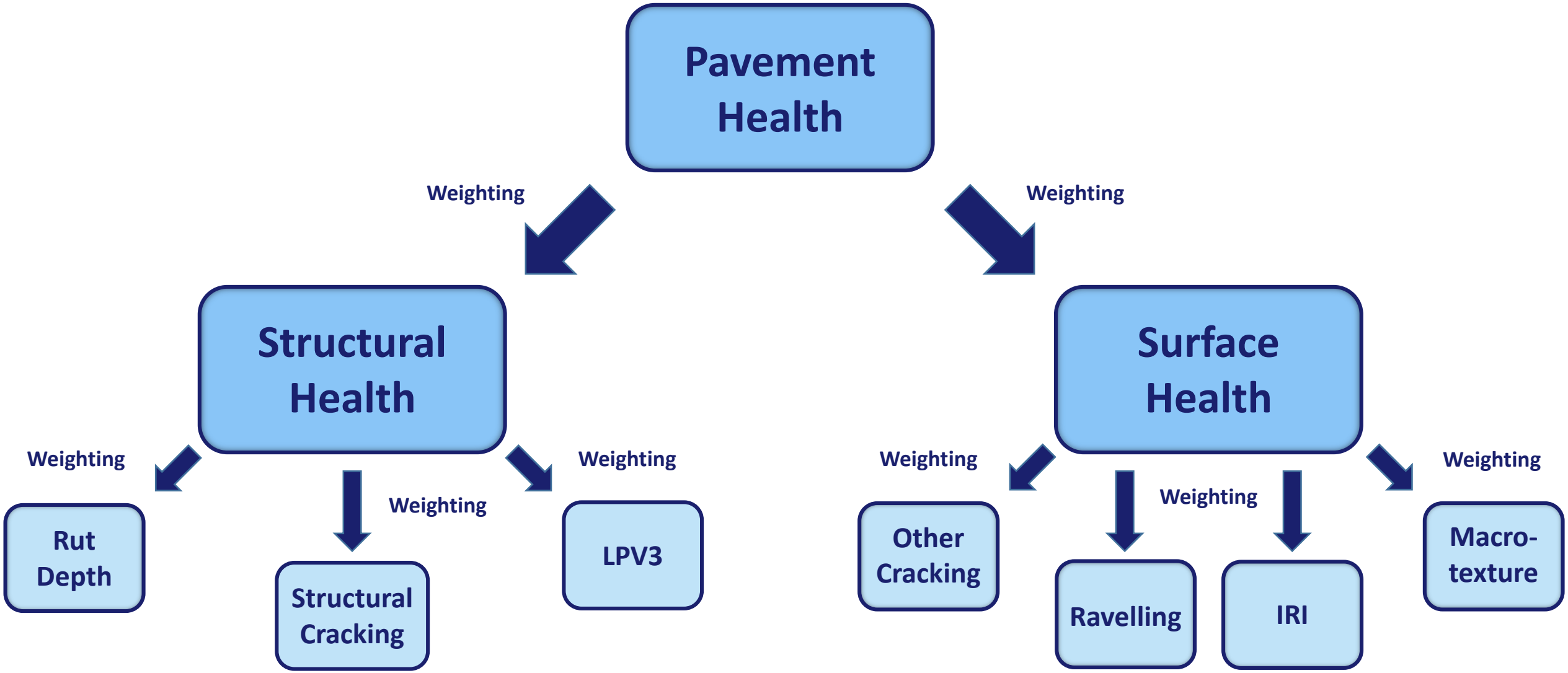
- A specific measure of performance that the agency hopes to achieve

Framework of TAM Pavement Parameters

Framework Strategic Objectives – Atkins Report

Strategic Objectives		Description
1	Carriageway Safety	Safety characteristics of carriageway surface
2	Pavement Health	Pavement performance
3	Value for Money	Use of investment to provide the best return for carriageway surface and structural maintenance
4	Investment in Maintenance	Investment need in carriageway surface and structural maintenance made to achieve long term benefits
5	Sustainability	Delivering an environmentally sustainable road network
6	Road user satisfaction	Meeting road user expectations

Pavement Health KPI



Carriageway Safety (Subnetwork 0)

Strategic Objective: Carriageway Safety		
Objective Category	**Performance measure / description**	
Carriageway Safety	Skidding Resistance	% of network above SCRIM Investigatory Level
	Rut Depth	% of network with rutting depth < 10 mm (*)
	Texture Depth	% of network with texture depth > 0.6 mm

(*) values to be confirmed

Carriageway Safety (Subnetworks 1-4)

Strategic Objective: Carriageway Safety		
Objective Category	**Performance measure / description**	
Carriageway Safety	Skidding Resistance	% of network above SCRIM Investigatory Level
	Rut Depth	% of network with rutting depth < 20 mm (*)
	Texture Depth	% of network with texture depth > 0.6 mm (*)

(*) values to be confirmed by NRA

Pavement Health

Strategic Objective: Pavement Health		
Objective Category	**Performance measure / description**	
Structural Health	Rut Depth	% of network with rut depth in condition category > 2
	Structural cracking	% of network with structural cracking in condition category > 2
	LPV3	% of network with LPV3 in condition category > 2
Surface Health	Other cracking	% of network with other cracking in condition category > 2
	Ravelling	% of network with ravelling in condition category > 2
	Macro-texture	% of network with macro-texture in condition category > 2
	International Roughness Index (IRI)	% of network with IRI in condition category > 2

2014

Objective: **Carriageway Safety**

Performance Measure SF1.1.2: Maximum Mean Rut Depth of 20mm								Overall Tactical Index 90.53%					
Road Hierarchy	LOS Banding					Performance measure (Operational)	Performance Measure (Tactical)	Performance / Hierarchy					Weighting Factors
Pavement Performance	Very Poor	Poor	Fair	Good	Very Good	% of roads above the maximum MRD	% of roads in condition better than Poor	Very Poor	Poor	Fair	Good	Very Good	
Subnet 0 (Motorways/Dual Carriageways)	> 9.00	≤ 9.00 > 6.00	≤ 6.00 > 5.00	≤ 5.00 > 3.00	≤ 3.00	0.1%	97.55%	0.13%	2.32%	4.45%	29.34%	63.76%	20%
Subnet 1 (Engineered Pavements)	> 9.00	≤ 9.00 > 6.00	≤ 6.00 > 5.00	≤ 5.00 > 3.00	≤ 3.00	2.4%	88.77%	2.43%	4.59%	4.10%	23.29%	65.59%	20%
Subnet 2 Legacy Pavements > 3500 AADT	> 15.00	≤ 15.00 > 9.00	≤ 9.00 > 6.00	≤ 6.00 > 4.00	≤ 4.00	1.7%		1.69%	6.22%	10.64%	17.32%	64.13%	20%
Subnet 3 Legacy Pavements 2000 to 3500 AADT	> 15.00	≤ 15.00 > 9.00	≤ 9.00 > 6.00	≤ 6.00 > 4.00	≤ 4.00	5.6%		5.64%	11.77%	12.74%	16.71%	53.13%	20%
Subnet 4 Legacy Pavements < 2000 AADT	> 20.00	≤ 20.00 > 15.00	≤ 15.00 > 9.00	≤ 9.00 > 6.00	≤ 6.00	4.7%		4.67%	7.90%	19.19%	15.53%	52.70%	20%

Trending and Visualisation

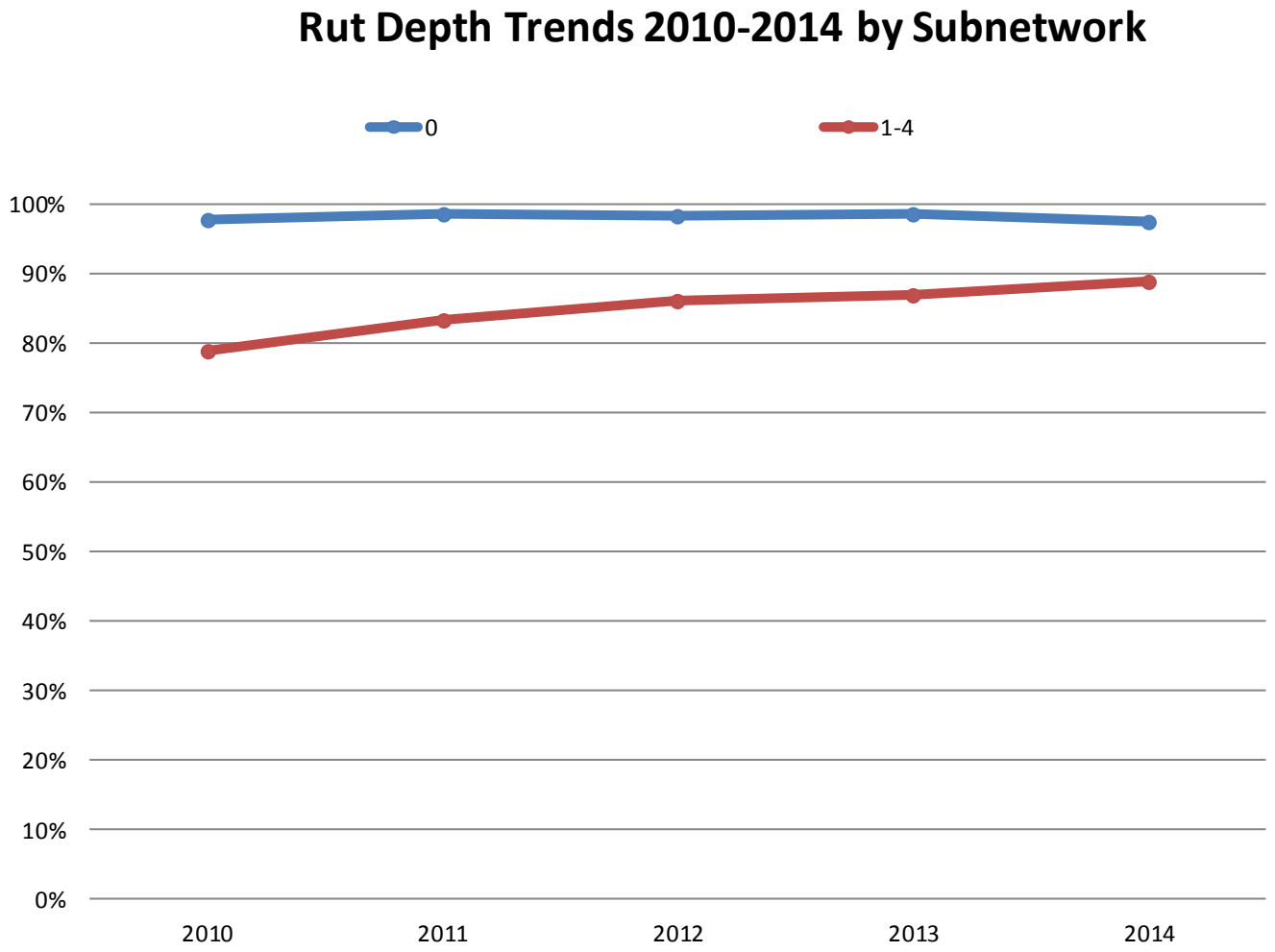
RUT DEPTH

Weighting Factors

Sum of %s	Subnet 0	Subnet 1	Subnet 2	Subnet 3	Subnet 4
100.0	20.0	20.0	20.0	20.0	20.0

% Better than Poor	2010	2011	2012	2013	2014
Subnet 0	97.7%	98.5%	98.4%	98.6%	97.6%
Subnets 1-4	78.8%	83.2%	86.2%	86.8%	88.8%

% Very Poor	2010	2011	2012	2013	2014
Subnet 0	0.4%	0.3%	0.3%	0.2%	0.1%
Subnet 1	4.4%	2.1%	2.6%	1.9%	2.4%
Subnet 2	5.3%	5.2%	2.5%	2.3%	1.7%
Subnet 3	12.5%	10.3%	7.6%	8.5%	5.6%
Subnet 4	9.9%	9.6%	5.5%	6.1%	4.7%


Rut Depth Trends 2010-2014 by Subnetwork
0
1-4
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2010
2011
2012
2013
2014

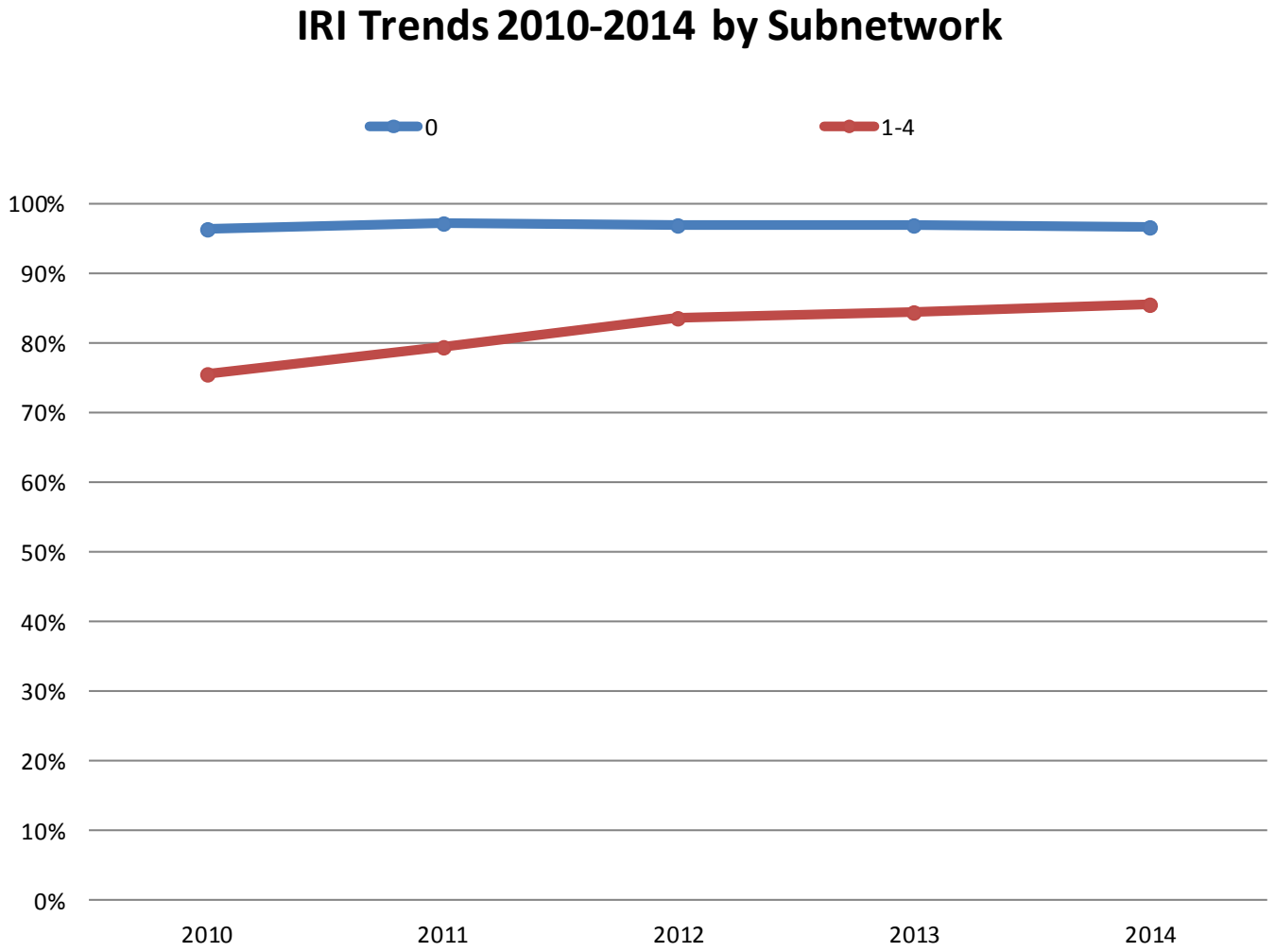
IRI

Weighting Factors

Sum of %s	Subnet 0	Subnet 1	Subnet 2	Subnet 3	Subnet 4
100.0	20.0	20.0	20.0	20.0	20.0

% Better than Poor	2010	2011	2012	2013	2014
Subnet 0	96.2%	97.1%	96.9%	97.0%	96.7%
Subnets 1-4	75.5%	79.5%	83.4%	84.4%	85.5%

% Very Poor	2010	2011	2012	2013	2014
Subnet 0	2.1%	1.5%	1.5%	1.5%	1.7%
Subnet 1	7.8%	5.8%	4.5%	3.7%	3.9%
Subnet 2	11.6%	9.6%	7.4%	6.8%	6.2%
Subnet 3	18.8%	15.9%	12.2%	12.1%	9.8%
Subnet 4	17.7%	14.5%	10.9%	10.2%	9.3%


IRI Trends 2010-2014 by Subnetwork
0
1-4
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2010
2011
2012
2013
2014

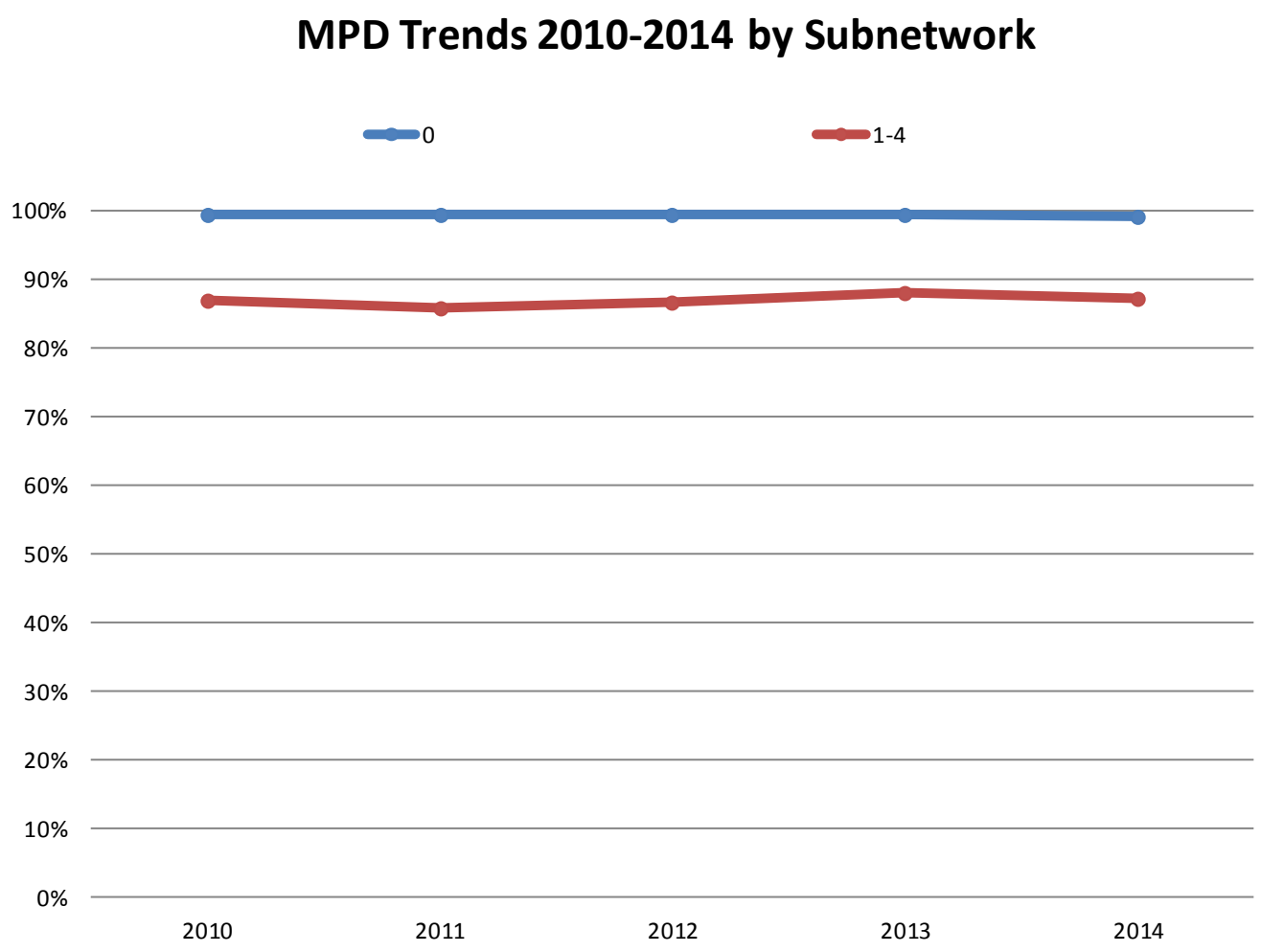
MPD

Weighting Factors

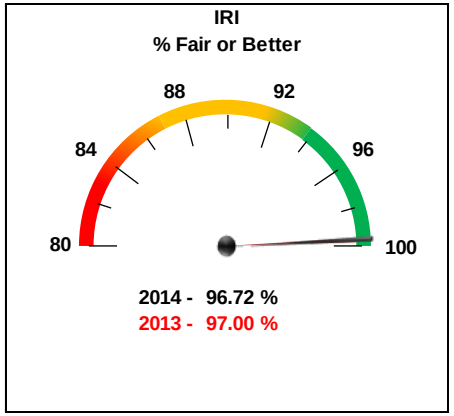
Sum of %s	Subnet 0	Subnet 1	Subnet 2	Subnet 3	Subnet 4
100.0	20.0	20.0	20.0	20.0	20.0

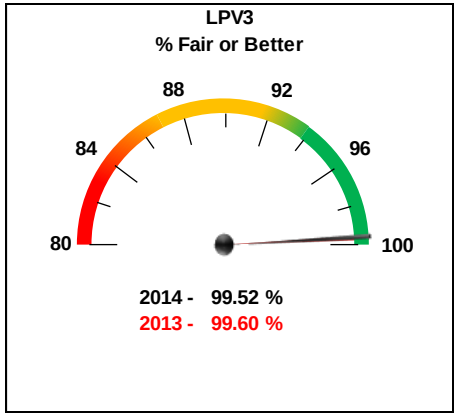
% Better than Poor	2010	2011	2012	2013	2014
Subnet 0	99.3%	99.4%	99.3%	99.3%	99.0%
Subnets 1-4	86.8%	85.9%	86.5%	87.9%	87.2%

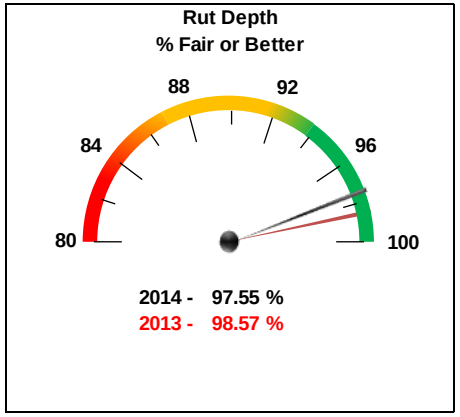
% Very Poor	2010	2011	2012	2013	2014
Subnet 0	0.0%	0.0%	0.0%	0.0%	0.0%
Subnet 1	0.5%	0.3%	0.4%	0.3%	0.6%
Subnet 2	1.3%	1.9%	2.2%	1.6%	1.9%
Subnet 3	1.3%	1.8%	1.6%	1.9%	2.2%
Subnet 4	1.2%	2.6%	2.0%	2.2%	2.7%

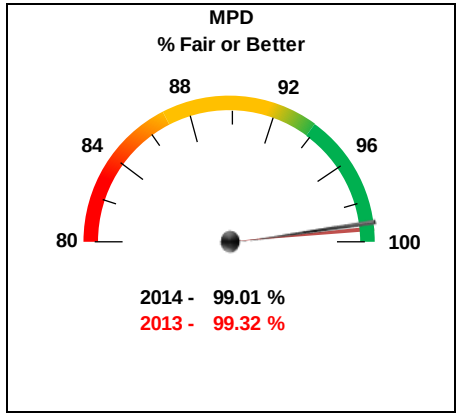

MPD Trends 2010-2014 by Subnetwork
0
1-4
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2010
2011
2012
2013
2014

Subnetwork 0

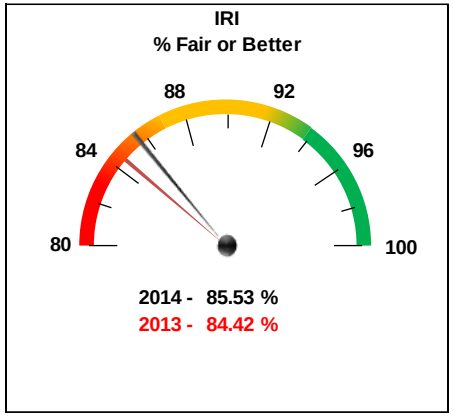


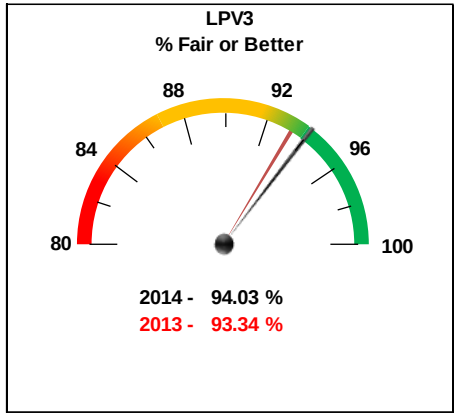


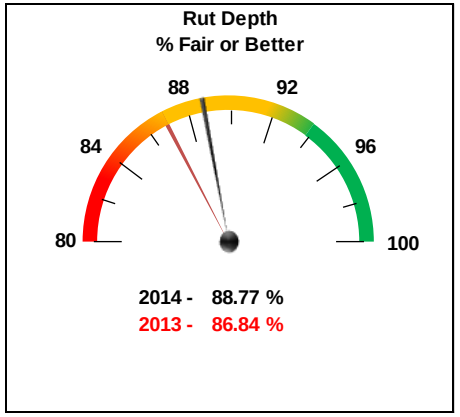


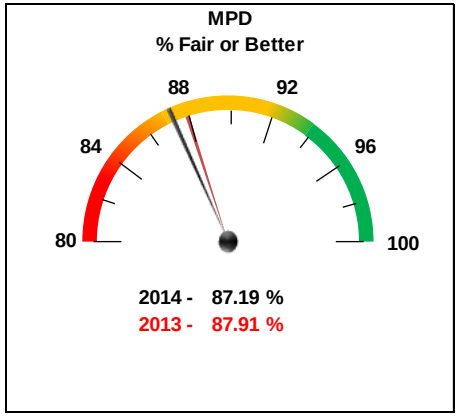


Subnetworks 1-4





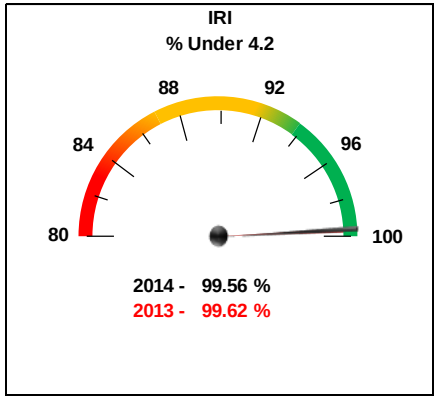


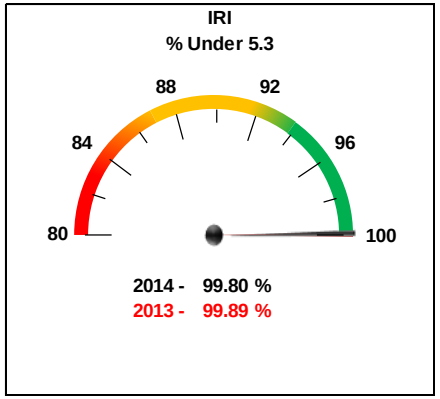


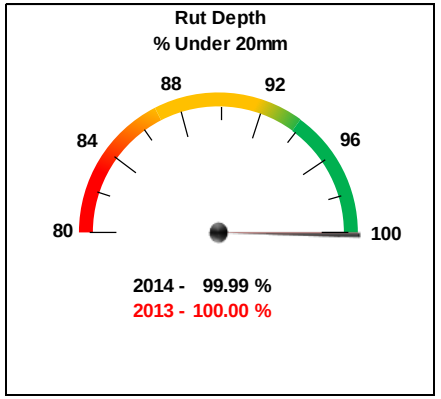
International Comparisons

Austroads – Target: 97% (IRI) 99% (Rut Depth)

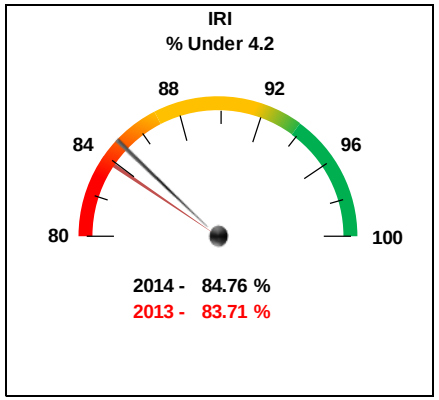
Subnetwork 0

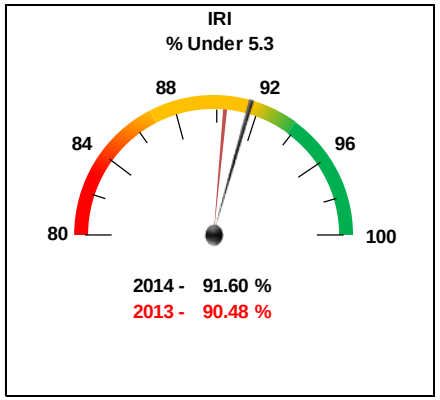


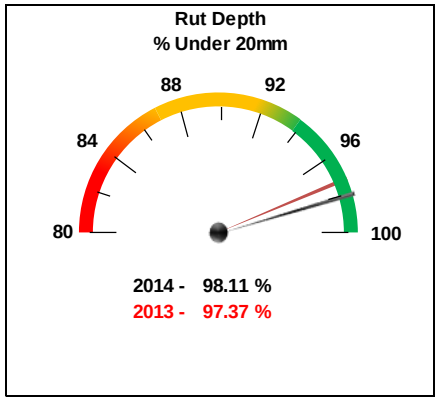




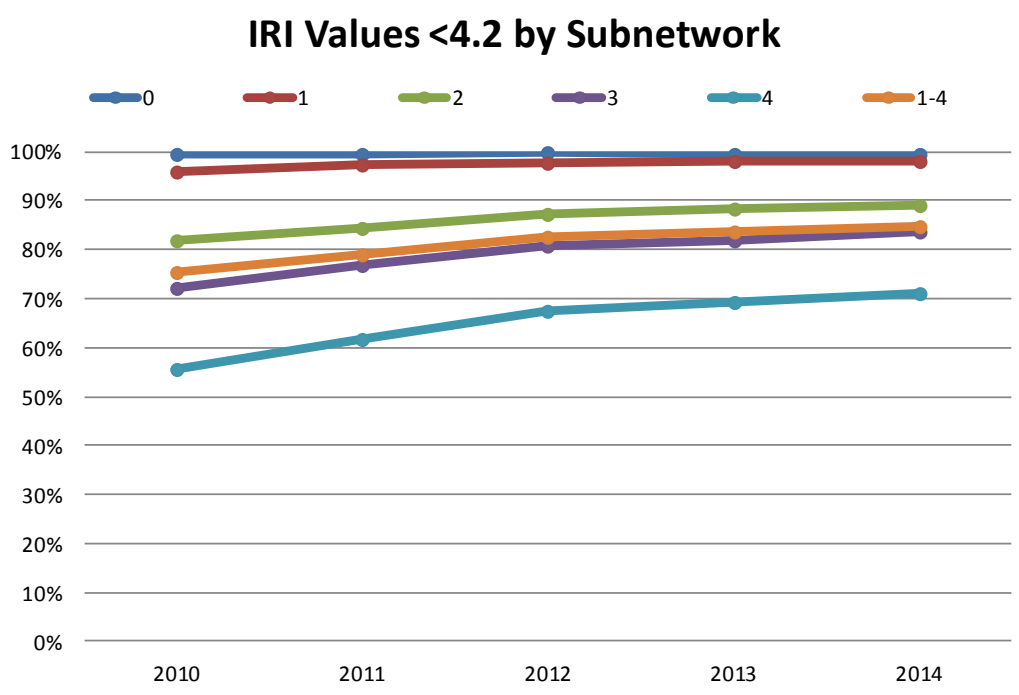
Subnetworks 1-4

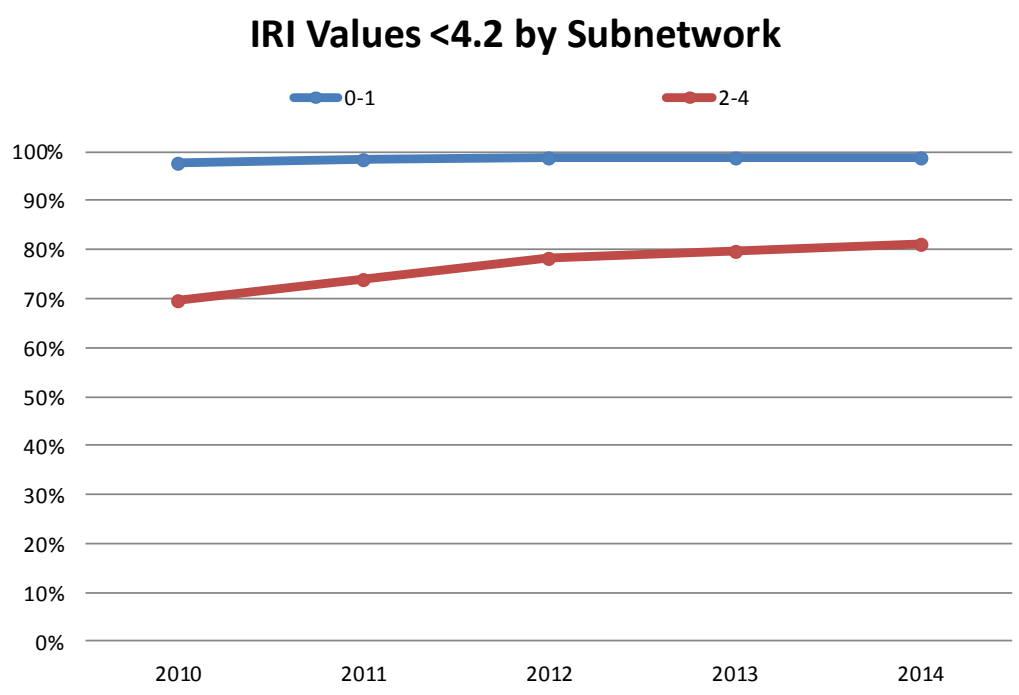




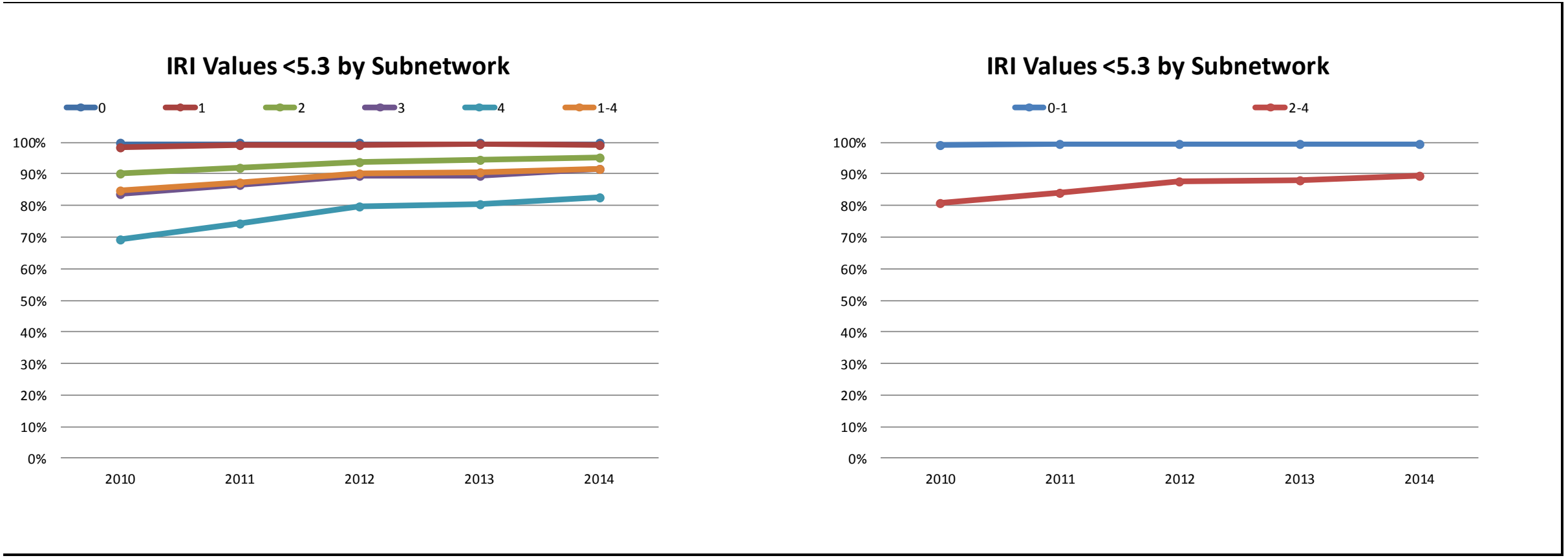


New Zealand: Target 97% - Subnetworks 0 and 1

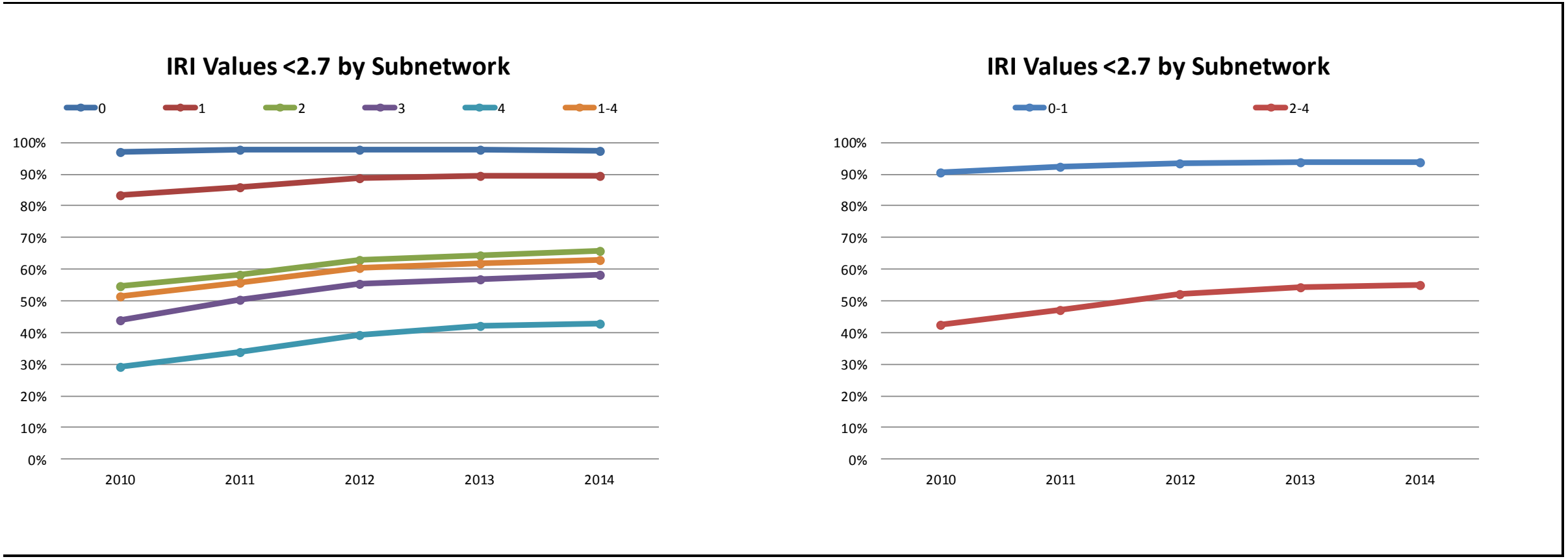




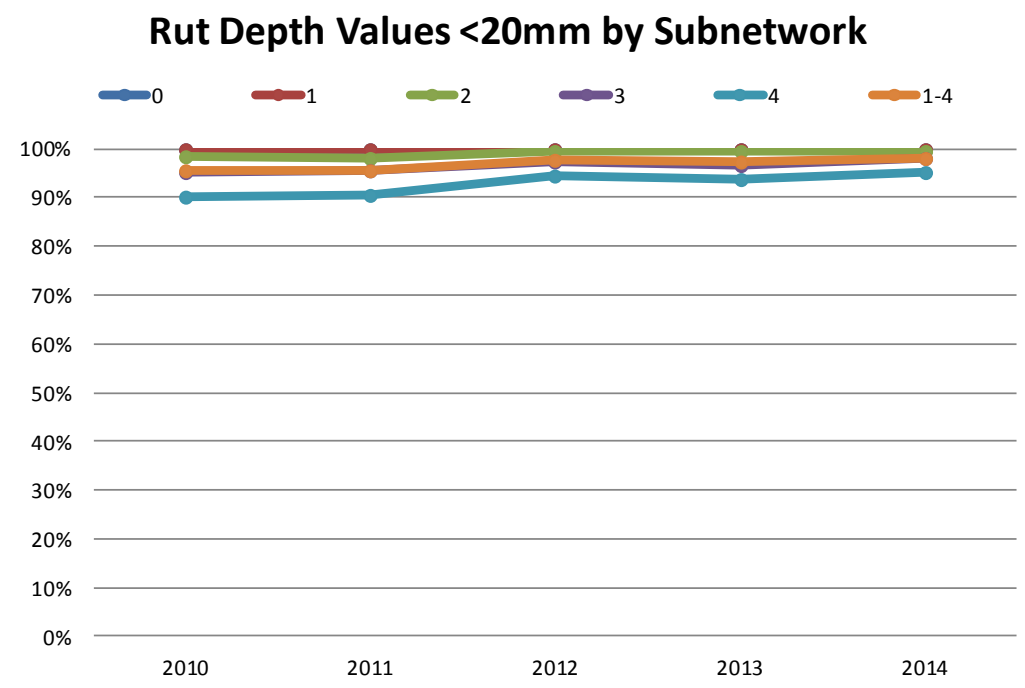
Austroads: Target 97% - subnets 2 to 4

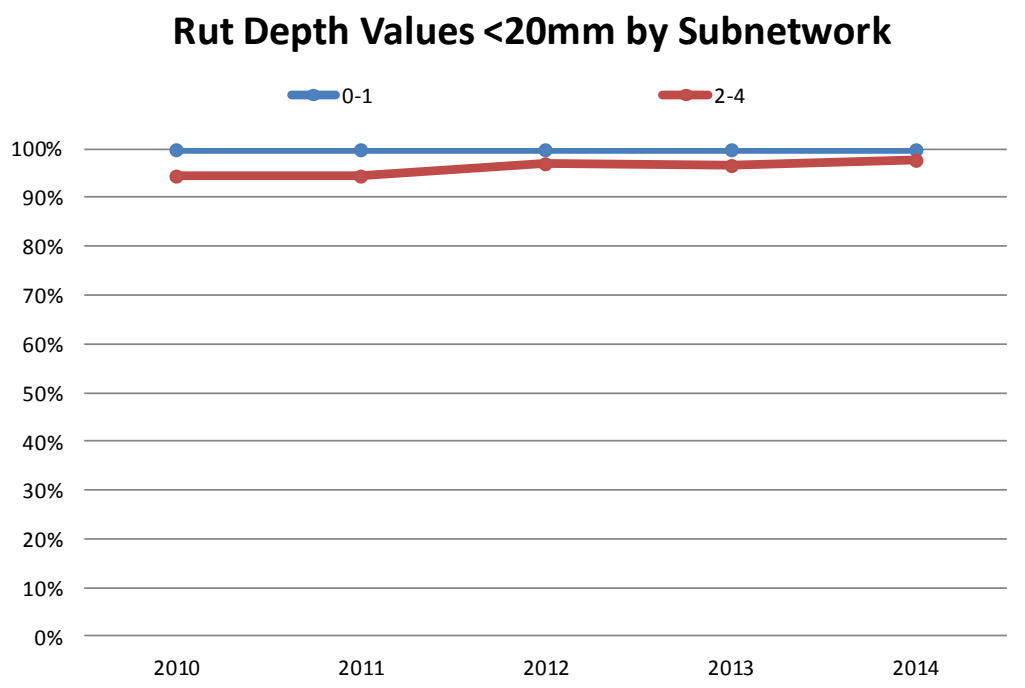


Virginia DOT – Target 85% overall (veh-km weighted)



New Zealand TA: Target 99%





Performance Brackets – Visualisation

Descriptive Brackets

LIRI

	Subnet 0		Subnet 1		Subnet 2		Subnet 3		Subnet 4		
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
V. Good	1.5		2		2.7		2.7		3		1
Good	2	1.5	2.5	2	3.2	2.7	3.2	2.7	4	3	2
Fair	2.5	2	3	2.5	4	3.2	4	3.2	5	4	3
Poor	3	2.5	3.5	3	5	4	5	4	7	5	4
V Poor		3		3.5		5		5		7	5

LRUT

	Subnet 0		Subnet 1		Subnet 2		Subnet 3		Subnet 4		
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
V. Good	3		3		4		4		6		1
Good	5	3	5	3	6	4	6	4	9	6	2
Fair	6	5	6	5	9	6	9	6	15	9	3
Poor	9	6	9	6	15	9	15	9	20	15	4
V Poor		9		9		15		15		20	5

M01 – 100 metre Data – Colour Charting

N01D1ML001	11	11.1	0.1	1	0	2	1	1	1
N01D1ML001	11.1	11.2	0.1	1	0	3	1	2	1
N01D1ML001	11.2	11.3	0.1	1	0	1	1	2	1
N01D1ML001	11.3	11.4	0.1	1	0	1	1	1	1
N01D1ML001	11.4	11.5	0.1	1	0	1	1	2	1
N01D1ML001	11.5	11.6	0.1	1	0	2	1	1	1
N01D1ML001	11.6	11.7	0.1	1	0	2	1	2	1
N01D1ML001	11.7	11.8	0.1	1	0	1	1	1	1
N01D1ML001	11.8	11.9	0.1	1	0	2	1	1	1
N01D1ML001	11.9	12	0.1	1	0	2	1	1	1
N01D1ML001	12	12.1	0.1	1	0	2	1	1	1
N01D1ML001	12.1	12.2	0.1	1	0	1	1	1	1
N01D1ML001	12.2	12.3	0.1	1	0	1	1	1	1
N01D1ML001	12.3	12.4	0.1	1	0	2	1	1	1
N01D1ML001	12.4	12.5	0.1	1	0	2	1	1	1
N01D1ML001	12.5	12.6	0.1	1	0	2	1	1	1
N01D1ML001	12.6	12.7	0.1	1	0	2	1	1	1
N01D1ML001	12.7	12.8	0.1	1	0	1	1	1	1
N01D1ML001	12.8	12.9	0.1	1	0	2	1	1	1
N01D1ML001	12.9	13	0.1	1	0	2	1	1	1

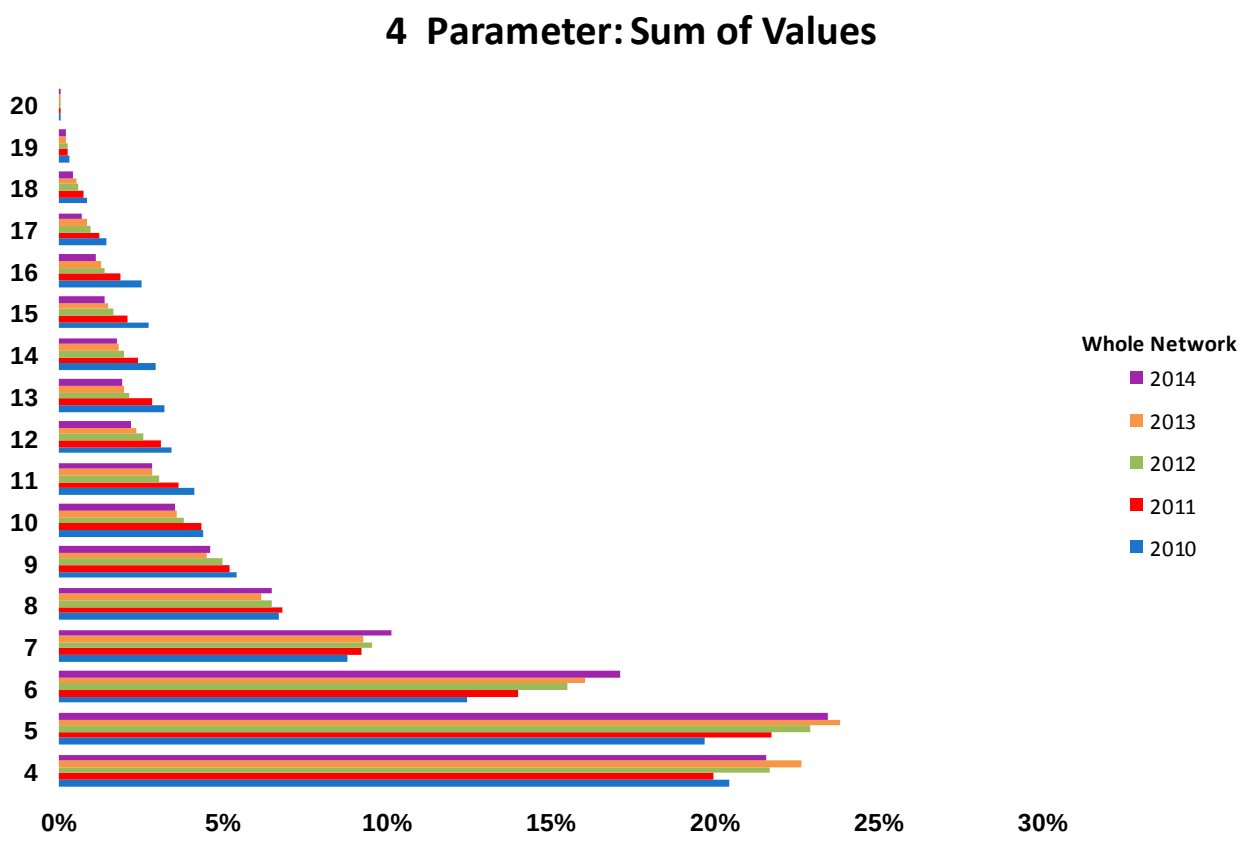
N70 and N71 – 100m data – Colour Charting

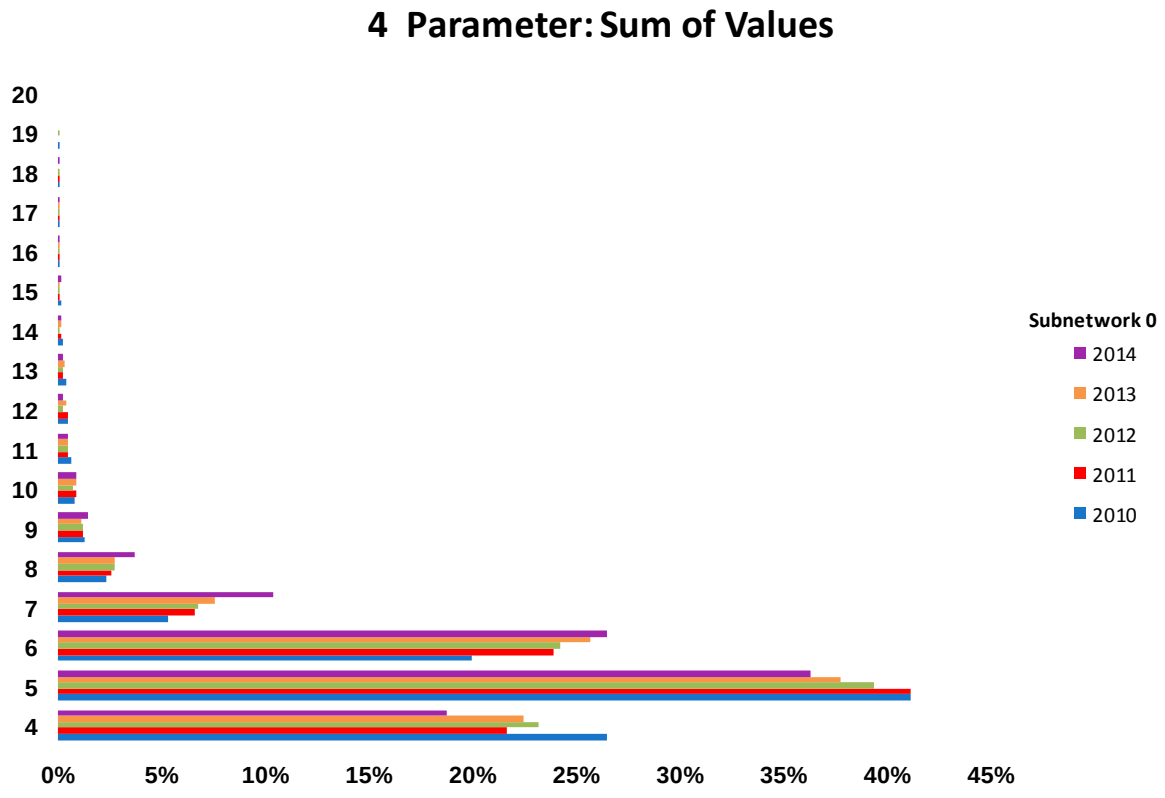
N70D1ML006	22.2	22.3	0.1	1	3	3	4	3	2
N70D1ML006	22.3	22.4	0.1	1	3	5	5	4	5
N70D1ML006	22.4	22.5	0.1	1	3	4	4	2	1
N70D1ML006	22.5	22.6	0.1	1	3	3	3	1	1
N70D1ML006	22.6	22.7	0.1	1	3	5	3	3	3
N70D1ML006	22.7	22.8	0.1	1	3	3	4	3	2
N70D1ML006	22.8	22.9	0.1	1	3	1	1	3	1
N70D1ML006	22.9	23	0.1	1	3	3	2	4	1
N70D1ML006	23	23.1	0.1	1	3	5	3	4	5
N70D1ML006	23.1	23.2	0.1	1	3	2	3	4	1
N70D1ML006	23.2	23.3	0.1	1	3	3	3	4	1
N70D1ML006	23.3	23.4	0.1	1	3	4	3	4	1
N70D1ML006	23.4	23.5	0.1	1	3	5	3	4	1
N70D1ML006	23.5	23.6	0.1	1	3	5	3	4	2
N70D1ML006	23.6	23.7	0.1	1	3	2	2	4	2
N70D1ML006	23.7	23.8	0.1	1	3	5	2	3	2
N70D1ML006	23.8	23.9	0.1	1	3	3	1	3	2
N70D1ML006	23.9	24	0.1	1	3	1	1	4	1
N71D2ML001	0	0.1	0.1	2	2	3	2	2	2
N71D2ML001	0.1	0.2	0.1	2	2	5	3	1	5
N71D2ML001	0.2	0.3	0.1	2	2	1	2	1	1
N71D2ML001	0.3	0.4	0.1	2	2	1	3	1	1
N71D2ML001	0.4	0.5	0.1	2	2	1	3	1	1
N71D2ML001	0.5	0.6	0.1	2	2	1	2	1	1
N71D2ML001	0.6	0.7	0.1	2	2	1	2	1	1
N71D2ML001	0.7	0.8	0.1	2	2	1	2	1	1
N71D2ML001	0.8	0.9	0.1	2	2	1	3	1	1

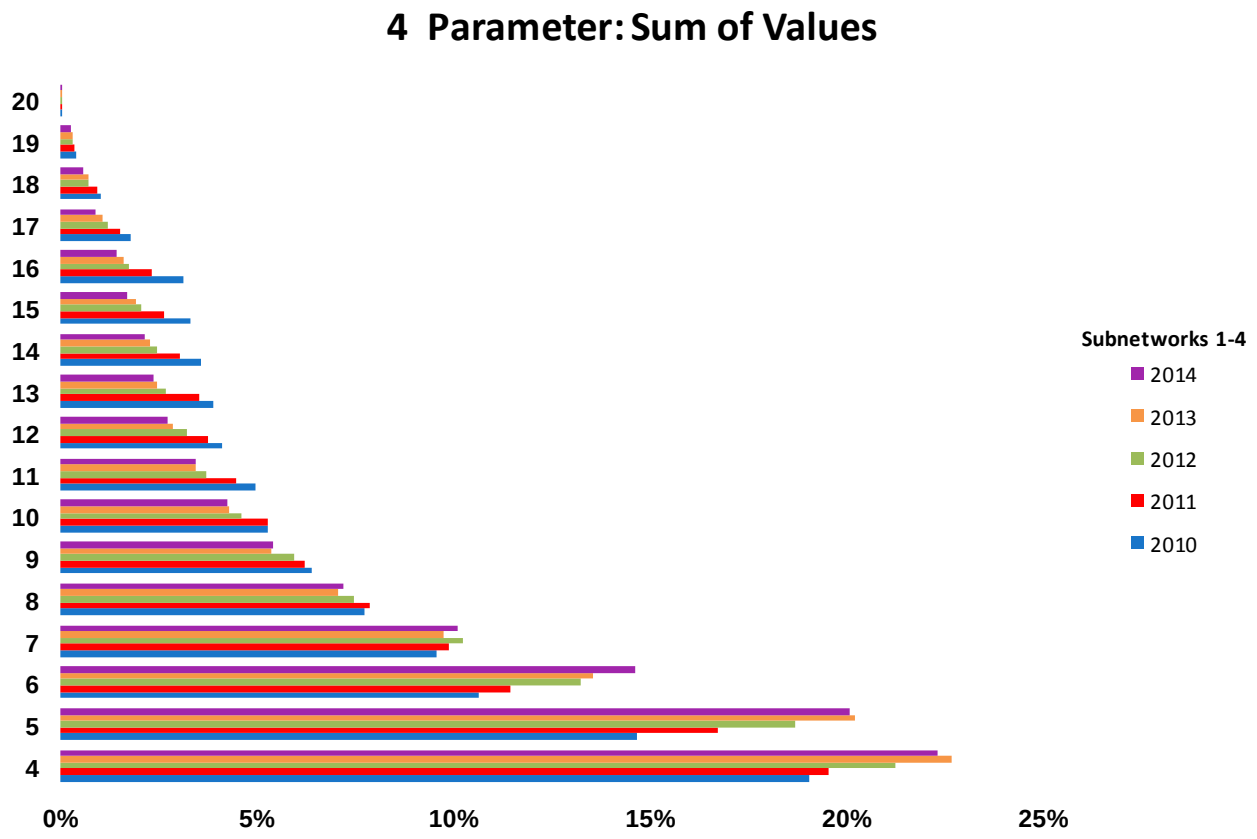
Whole Network

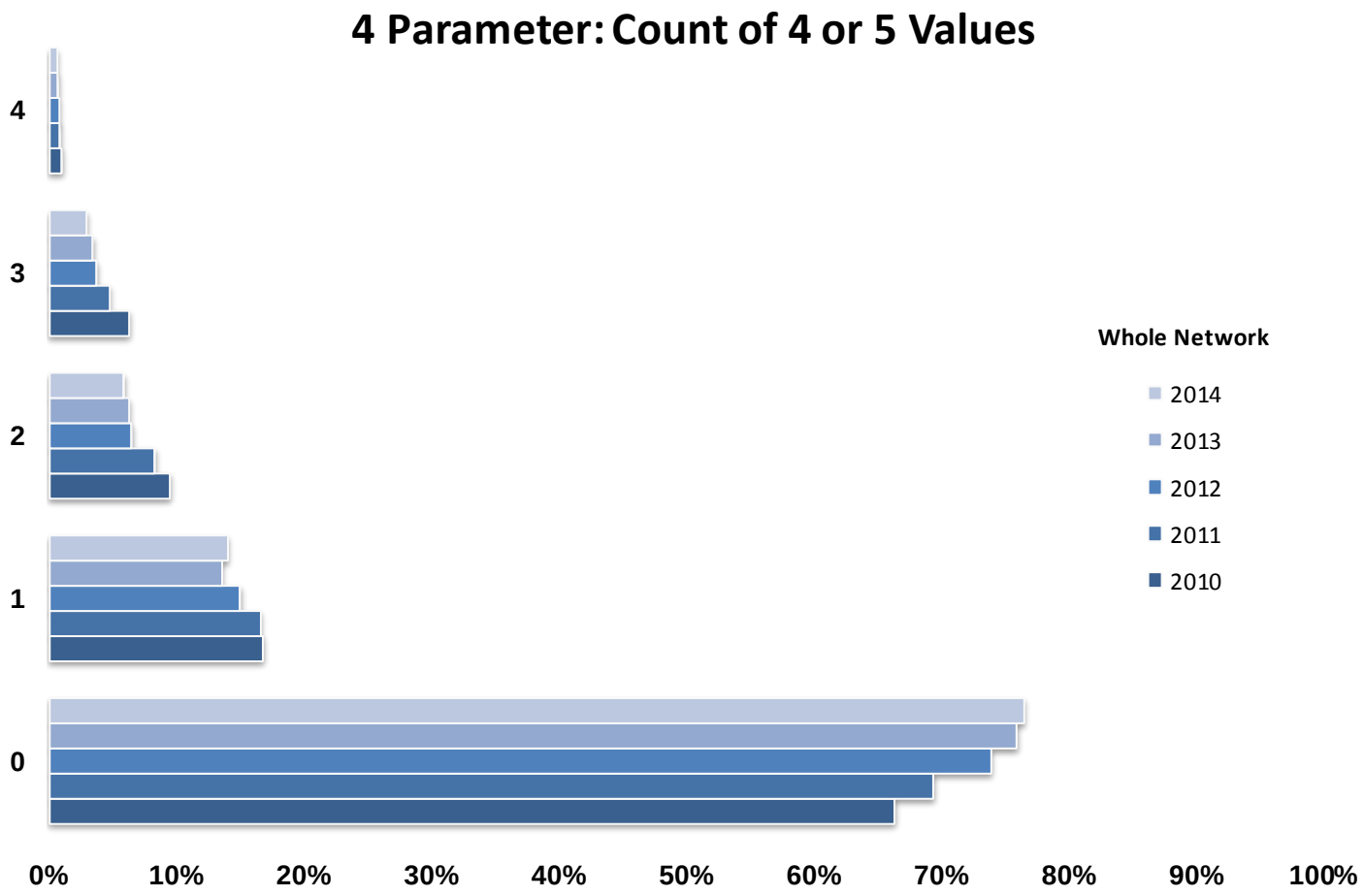
Sum %s

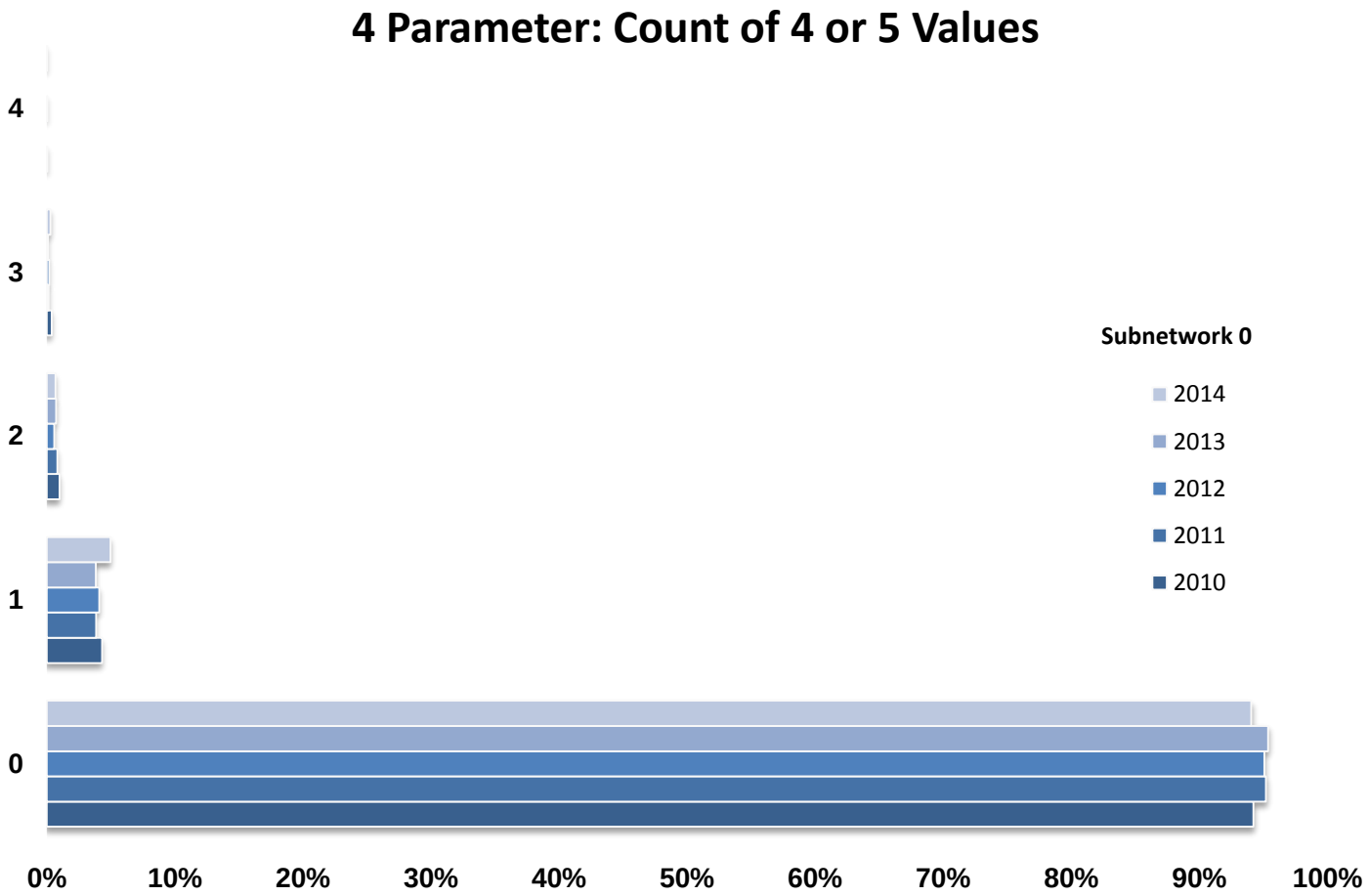
Sum Totals	2010	2011	2012	2013	2014
4	20.5%	20.0%	21.7%	22.7%	21.6%
5	19.8%	21.8%	23.0%	23.9%	23.5%
6	12.5%	14.0%	15.5%	16.1%	17.1%
7	8.8%	9.2%	9.6%	9.3%	10.2%
8	6.7%	6.8%	6.5%	6.2%	6.5%
9	5.4%	5.2%	5.0%	4.5%	4.6%
10	4.4%	4.4%	3.9%	3.6%	3.6%
11	4.2%	3.7%	3.1%	2.9%	2.9%
12	3.5%	3.1%	2.6%	2.4%	2.2%
13	3.2%	2.9%	2.2%	2.0%	2.0%
14	3.0%	2.5%	2.0%	1.9%	1.8%
15	2.7%	2.1%	1.7%	1.5%	1.4%
16	2.6%	1.9%	1.4%	1.3%	1.2%
17	1.5%	1.2%	1.0%	0.9%	0.7%
18	0.9%	0.8%	0.6%	0.6%	0.5%
19	0.3%	0.3%	0.3%	0.2%	0.2%
20	0.0%	0.0%	0.0%	0.0%	0.0%

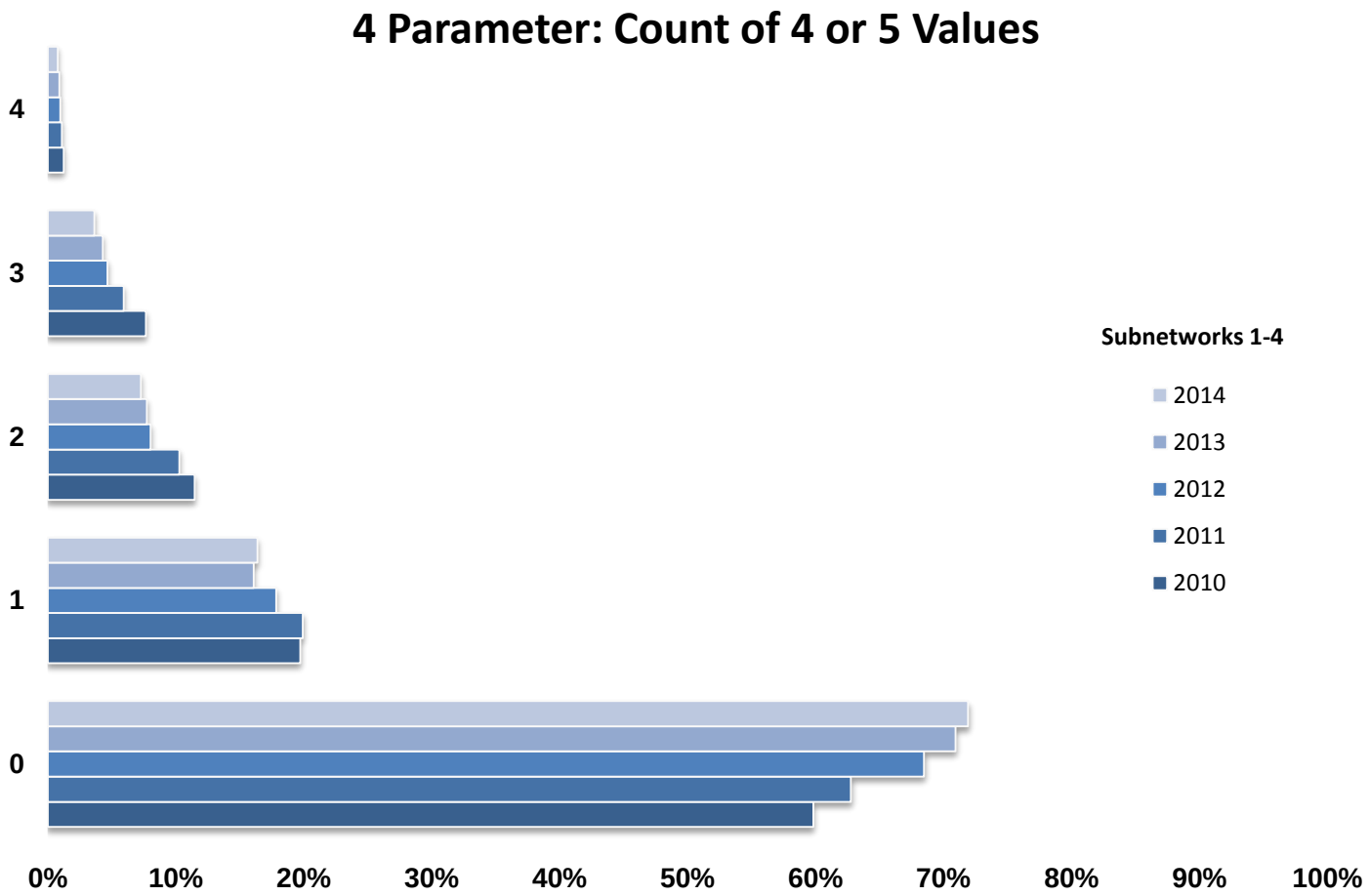

4 Parameter: Sum of Values
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
0%
5%
10%
15%
20%
25%
30%
Whole Network
2014
2013
2012
2011
2010

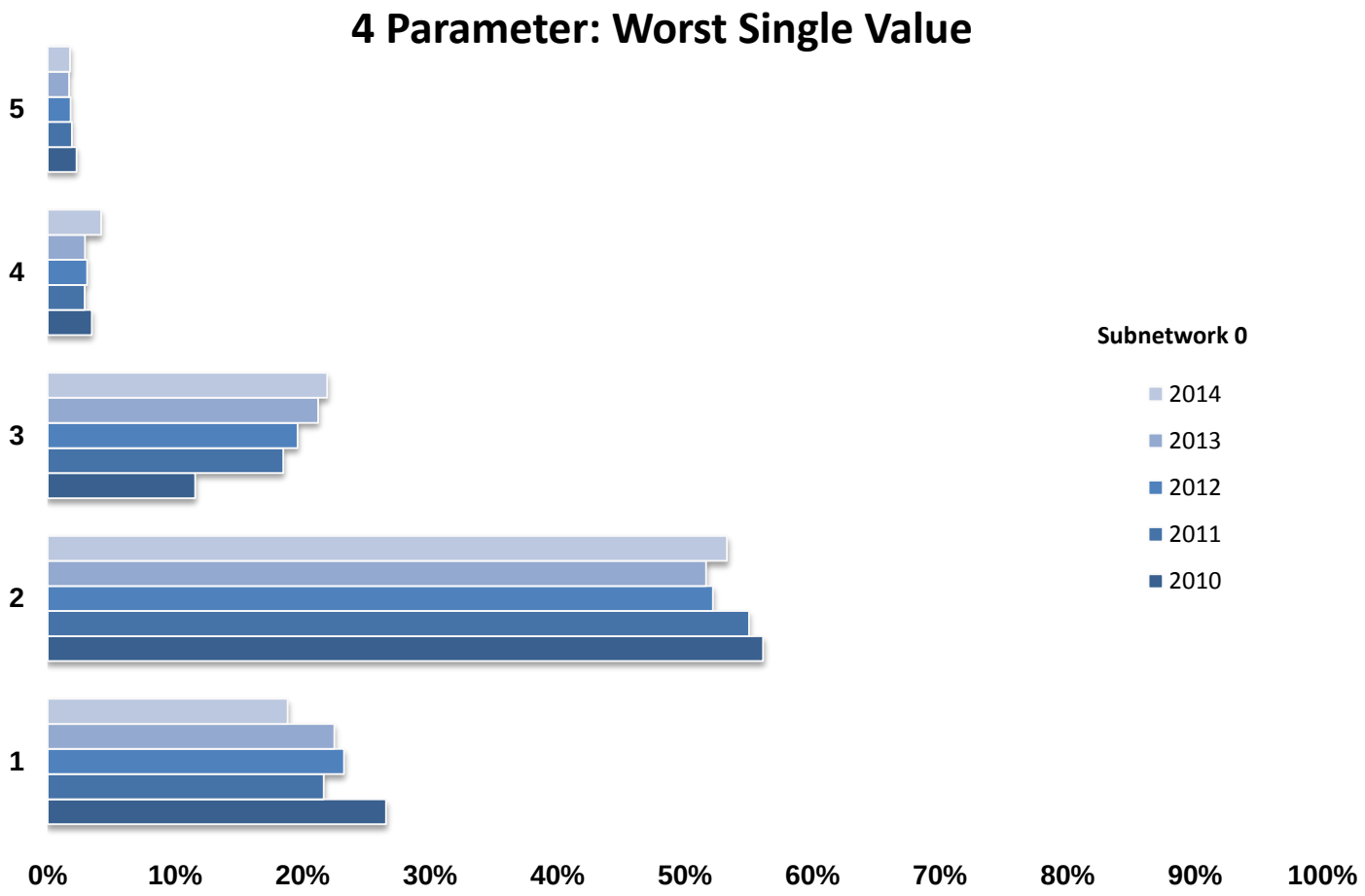

4 Parameter: Sum of Values
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
Subnetwork 0
2014
2013
2012
2011
2010

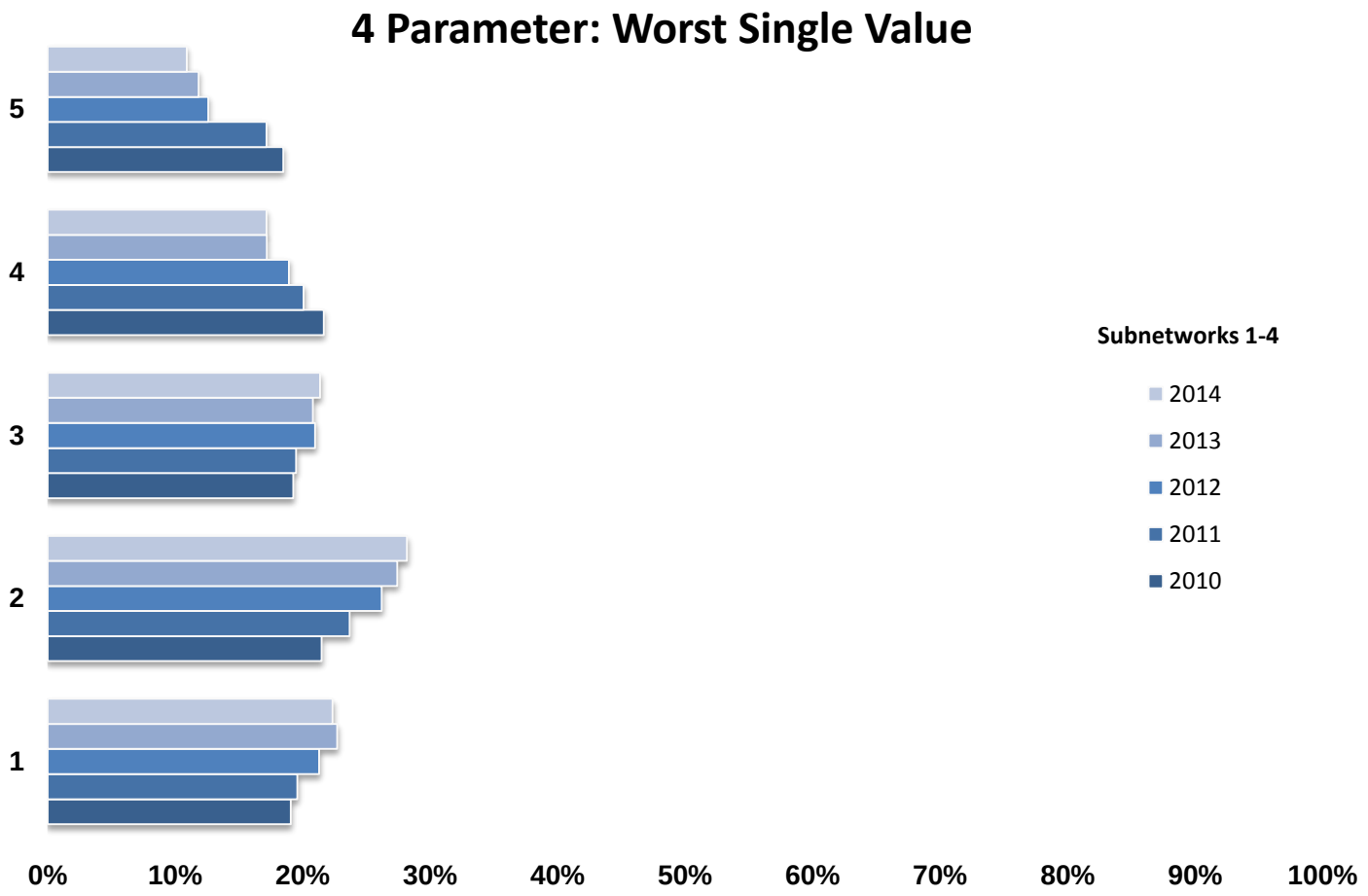

4 Parameter: Sum of Values
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
0%
5%
10%
15%
20%
25%
Subnetworks 1-4
2014
2013
2012
2011
2010


4 Parameter: Count of 4 or 5 Values
4
3
2
1
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Whole Network
2014
2013
2012
2011
2010


4 Parameter: Count of 4 or 5 Values
4
3
2
1
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Subnetwork 0
2014
2013
2012
2011
2010


4 Parameter: Count of 4 or 5 Values
4
3
2
1
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Subnetworks 1-4
2014
2013
2012
2011
2010


4 Parameter: Worst Single Value
5
4
3
2
1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Subnetwork 0
2014
2013
2012
2011
2010


4 Parameter: Worst Single Value
5
4
3
2
1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Subnetworks 1-4
2014
2013
2012
2011
2010

Summary

SMART Method of Evaluating Measures

- **S**pecific
- **M**easurable
- **A**chievable
- **R**esults Oriented
- **T**imely

Framework's Strategic Objectives

Strategic Objectives		Description
1	Carriageway Safety	Safety characteristics of carriageway surface
2	Pavement Health	Pavement performance
3	Value for Money	Use of investment to provide the best return for carriageway surface and structural maintenance
4	Investment in Maintenance	Investment need in carriageway surface and structural maintenance made to achieve long term benefits
5	Sustainability	Delivering an environmentally sustainable road network
6	Road user satisfaction	Meeting road user expectations