THREE METHODS FOR MEASURING CONSTRUCTION'S ROLE IN THE ECONOMY

Gerard de Valence

Topics

- The national accounting framework and the Standard Industrial Classification of industries
- Three national SIC variants and 41.1:
  - Australian and New Zealand System of Industrial Classification (ANZSIC)
  - North American Industry Classification System (NAICS)
  - The EU NACE and the UK Standard Industrial Classification
- Gross Fixed Capital Formation (GFCF)
- The Built Environment Sector (BES)

System of National Accounts

- The internationally accepted standard for presentation of national accounts is the United Nations System of National Accounts (UN SNA 1963, and much revised since, most recent 2003).

- This lays out guidelines for the methods to be used in data collection and analysis, which are then interpreted and applied by individual countries, with idiosyncratic results.

- The conventions followed in collection and definition of data differ between countries, affecting international comparisons. Also, data methodologies change within countries, which further complicates the long-term analysis necessary in estimation of trends.

National Accounts

- National accounts are the annual publication of a country's statistical collections relating to economic activity.

- The estimates of national production, income and output – the triple identity – bring together consumer expenditure, government revenues and expenditures, savings and investment, imports and exports and the balance of payments.

- This statistical system has been developed over 70 years, and provides a useful picture of economic structure, defines the data required and simplifies the task of collection.

GDP = C + I + G + NX

- The basic macroeconomic model adds expenditure to get GDP as Consumption + Investment + Government + Net exports. Also called Aggregate Demand. Total production is Aggregate Supply.

- Variations from year to year in Net Exports, Consumption and Government expenditures are usually small relative to their total amount of spending (i.e. are changes at the margin).

- Therefore changes in Investment expenditure typically creates the peaks and troughs in the business cycle, and building and construction is the most volatile part of investment.

National Accounting Framework

Note:

1. Shown as percent change on previous year, except Labour market.

2. Outcomes for revenues and expenditures are very sensitive to forecasts of growth rates and changes in employment.

	Outcomes(b)	Forecasts		
	2017-18	2018-19	2019-20	2020-21
Real gross domestic product	**2.8**	**2 1/4**	**2 3/4**	**2 3/4**
Household consumption	**2.8**	2 1/4	2 3/4	3
Dwelling investment	**0.2**	1/2	-7	-4
Total business investment(c)	**6.0**	1	5	4 1/2
By industry				
Mining investment	**-4.1**	-10 1/2	4	4 1/2
Non-mining investment	**9.7**	4 1/2	5 1/2	4 1/2
Private final demand(c)	**3.0**	1 1/2	2 1/4	2 3/4
Public final demand(c)	**4.5**	5 1/2	3 1/4	3
Change in inventories(d)	**0.0**	0	0	0
Gross national expenditure	**3.4**	2 1/2	2 1/2	2 3/4
Exports of goods and services	**4.1**	3 1/2	4	1 1/2
Imports of goods and services	**7.1**	1 1/2	3	2 1/2
Net exports(d)	**-0.6**	1/2	1/4	- 1/4
Nominal gross domestic product	**4.7**	5	3 1/4	3 3/4
Prices and wages				
Consumer price index(e)	**2.1**	1 1/2	2 1/4	2 1/2
Wage price index(f)	**2.1**	2 1/2	2 3/4	3 1/4
GDP deflator	**1.8**	2 1/2	1/2	1
Labour market				
Participation rate (per cent)(g)	**65.6**	65 1/2	65 1/2	65 1/2
Employment(f)	**2.7**	2	1 3/4	1 3/4
Unemployment rate (per cent)(g)	**5.4**	5	5	5
Balance of payments				
Terms of trade(h)	**1.9**	4	-5 1/4	-4 3/4
Current account balance (per cent of GDP)	**-2.8**	-1 3/4	-2 3/4	-3 3/4

Measurement

- Dynamic economies have frequent improvements in quality across many different products, new products and services are constantly invented and introduced, old models are discontinued, and some products are custom built.

- The composition and contribution of different industries changes over time, known as structural change.

- Some physical units of output are not standardised or homogeneous, and non-standard products are a problem for output measurement. The building and construction industry is an archetype of an industry with non-standardised products, other industries are shipbuilding, aircraft manufacture and many professional services.

Work done and industry value added

CONSTRUCTION INDUSTRY OUTPUT

Standard Industrial Classification

- The macroeconomic aggregates in the national accounts are at too high a level to capture all economic activity, particularly the activity of companies (in the market sector) and other organisations (in the non-market sector, such as health or non-profit).

- An industry classification system collects companies and organisations into groups with similar characteristics.

- The first Standard Industrial Classification of All Economic Activities (SIC) was the US in 1937, with the United Nations International Standard Industrial Classification (ISIC) following in 1948. This had its most recent revision in 2008.

SIC Codes

- Economic activities are subdivided in a four-level structure with the highest level alphabetically coded sections.
  - Sections subdivide productive activities into broad groupings such as “Agriculture, forestry and fishing” (A), “Manufacturing” (C) and “Information and communication” (J).

- The classification is then organized into numerically coded categories, which are two-digit divisions, three-digit groups, and, four-digit classes (which have the greatest level of detail).

- SIC codes are therefore four-digit numbers representing industries, on the basis of common characteristics in products, services, production processes and logistics systems between members.

Section	Divisions	ISIC Industry
A	1-3	Agriculture, forestry and fishing
B	5-9	Mining and quarrying
C	10-33	Manufacturing
D	35	Electricity, gas, steam and air conditioning supply
E	36-39	Water supply; sewerage, waste management and remediation
F	41-43	Construction
G	45-47	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	49-53	Transportation and storage
I	55-56	Accommodation and food service activities
J	58-63	Information and communication
K	64-66	Financial and insurance activities
L	68	Real estate activities
M	69-75	Professional, scientific and technical activities
N	77-82	Administrative and support service activities
O	84	Public administration and defence; compulsory social security
P	85	Education
Q	86-88	Human health and social work activities
R	90-93	Arts, entertainment and recreation
S	94-96	Other service activities
T	97-98	Activities of households as employers; undifferentiated activities of households for own use
U	99	Activities of extraterritorial organizations and bodies

Australian SIC Revisions

ASIC 1983	ANZSIC 1994	ANZSIC 2006
Agriculture, forestry, fishing, hunting	Agriculture, forestry and fishing	Agriculture, forestry and fishing
Mining	Mining	Mining
Manufacturing	Manufacturing	Manufacturing
Electricity, gas and water	Electricity, gas and water supply	Electricity, gas and water supply
Construction	Construction	Construction
Wholesale and retail trade	Wholesale trade Retail trade	Wholesale trade Retail trade
Transport and storage	Transport and storage	Transport, postal and warehousing
Communication	Communication services	Information media and telecommunications
Finance, property and business services	Finance and insurance Property and business services	Financial and insurance services Rental, hiring and real estate services Professional, scientific and technical services
Public administration and defence	Government administration and defence	Administrative and support services Public administration and safety
Community Services	Education Health and community services	Education and training Health care and social assistance
Recreation, personal, other services	Accommodation, cafes and restaurants Cultural and recreational services Personal and other services	Accommodation and food services Arts and recreation services Other services

Section F - Construction

- Construction in the SIC includes three groups:
  - The complete construction of buildings (division 41).
  - The complete construction of civil engineering works (division 42).
  - Specialized construction activities or special trades (division 43).
  - This data is first released as Work Done, or activity, a gross measure of total expenditure that is typically collected by surveys.
  - It will be incorporated into the national accounts as industry value added, or revenue minus costs, after activity data is included in the supply and use tables, which are product based and track flows between industries.

- Countries have a similar structure at the two and three digit levels, but there are differences. Comparison of ISIC and the Australian (ANZSIC), European (NACE) and North American (NAICS) classification systems follows.

Comparing Countries

F	ISIC Rev 4	E	ANZSIC 2006
41	Construction of buildings	30	Building construction
410	Construction of buildings		
4100	Construction of buildings	3011	House construction
		3019	Other residential building construction
		3020	Non-residential building construction
42	Civil engineering	31	Heavy and civil engineering construction
421	Construction of roads and railways		
4210	Construction of roads & railways	3101p	Road and bridge construction
		3109p	Other heavy and civil engineering
		3299p	Other construction services n.e.c.
422	Construction of utility projects		
4220	Construction of utility projects	3109p	Other heavy and civil engineering
429	Construction of other civil engineering projects		
4290	Construction of other civil engineering projects	3101p	Road and bridge construction
		3109p	Other heavy and civil engineering
		3211p	Land development and subdivision

United Nations ISIC	ANZSIC	NACE	NAICS
Section F Construction	*Section E Construction*	*Section F Construction*	*23 Construction*
4100 Construction of buildings	30 Building construction	41 Construction of buildings	236 Construction of Buildings
		41.1 Development of building projects	
Single-family houses	301 Residential building construction	41.202 Construction of domestic buildings	2361 Residential building construction
Multi-family buildings, including high-rise buildings			
Construction of all types of non-residential buildings	302 Non-residential building construction	41.201 Construction of commercial buildings	2362 Non-residential building construction
Buildings for industrial production			23622 Commercial and institutional building
42 Civil engineering	31 Heavy and civil engineering construction	42 Civil engineering	237 Heavy and civil engineering construction

United Nations ISIC	ANZSIC	NACE	NAICS
Section F Construction	*Section E Construction*	*Section F Construction*	*23 Construction*
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EU System

- NACE Rev 2 from 2008 is the statistical classification of economic activities in the European Community. Also used for the UK SIC. Called NACE after French title.

- Section F includes general construction and specialised construction activities for buildings and civil engineering works. It includes new work, repair, additions and alterations, and prefabricated and temporary buildings.

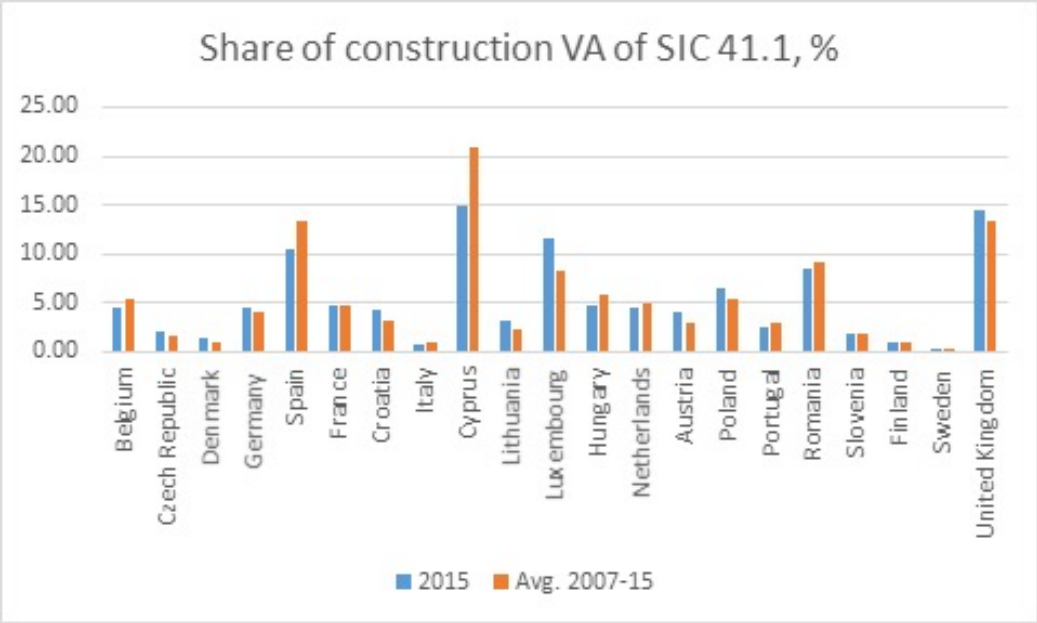
- NACE classifies services to buildings and landscape activities under administrative and support service activities, not construction.
  - ANZSIC classifies landscaping under construction.

NACE

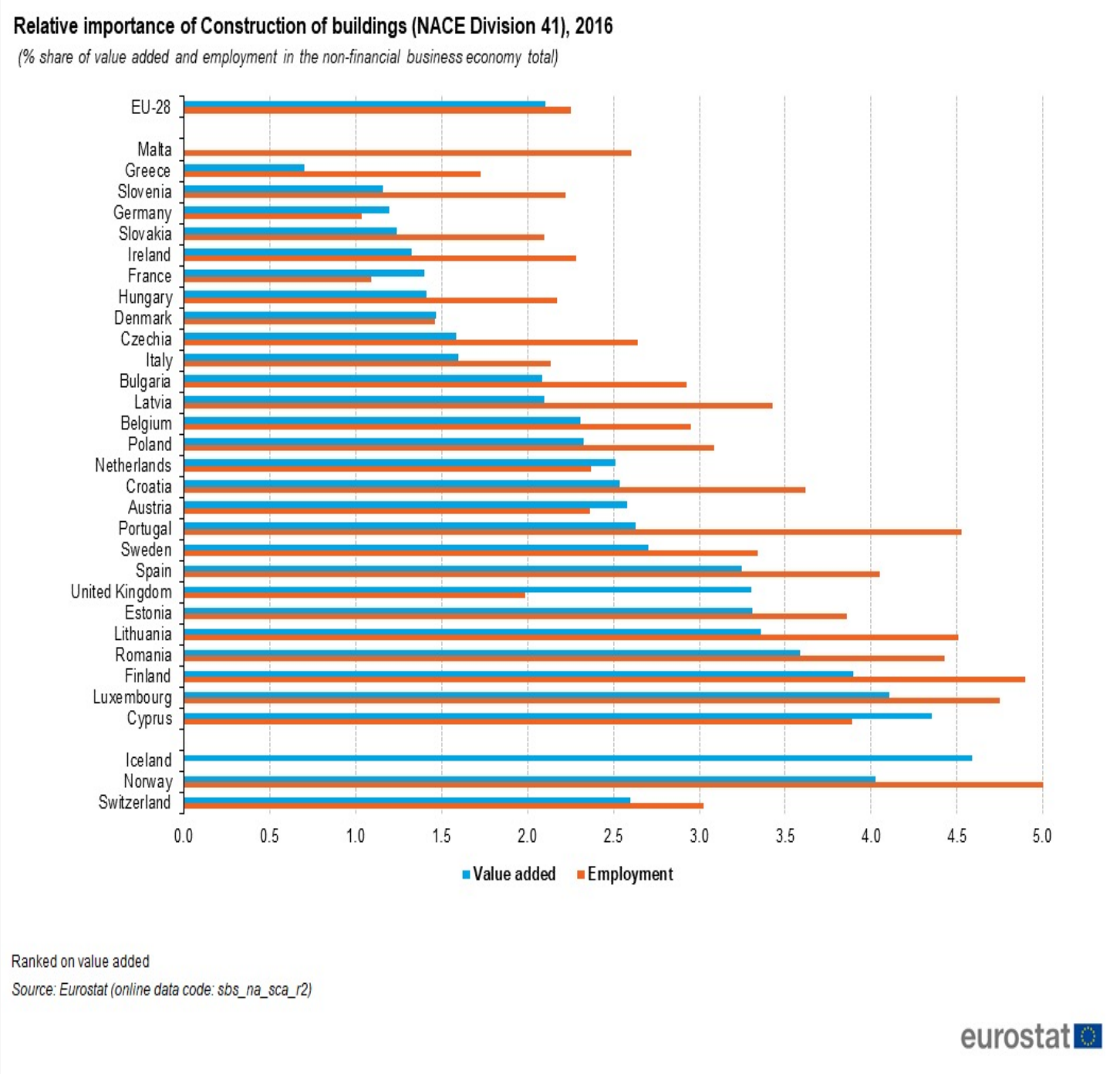
- The 2008 revision introduced a new subdivision, SIC 41100 The Development of Building Projects.
  - ISIC has no such activity within the construction industry. ANZSIC has SIC code 3211 for Land development and site preparation, but this excludes firms subdividing land without site preparation.
  - NAICS has SIC code 2372: Land subdivision. However, 23721 excludes much of what is included in 41100 and is more similar to ANZSIC.

- The Development of building projects: “for buildings or civil engineering works by bringing together financial, technical and physical means to realise the construction projects for later sale”. This is the same as UK’s Group and Class 41.10.
  - If these activities are carried out not for later sale but for their operation (e.g. rental of space, manufacturing activities), the unit would not be classified here but according to its operational activity (i.e. real estate, manufacturing).

Measuring Construction Inconsistently



"The inclusion of the subdivision 41.1 in NACE distorts the data on the European construction industry. It is unevenly and unreliably reported across the 28 countries, but for a few countries it is a significant share of construction output. The NACE inclusion of Development of Building Projects in construction should be taken into account when making international comparisons, as the contribution of this subdivision 41.1 to industry output significantly increases the industry total in a few countries across the EU, but is either not reported or not included by counties using the ISIC, ANZSIC and NAICS systems" (de Valence 2018).



Industry output is measured as:

Value added = Sales + changes in inventories less purchases.

Construction activity is measured as:

Gross output = Purchases + Compensation of labour + Gross operating surplus

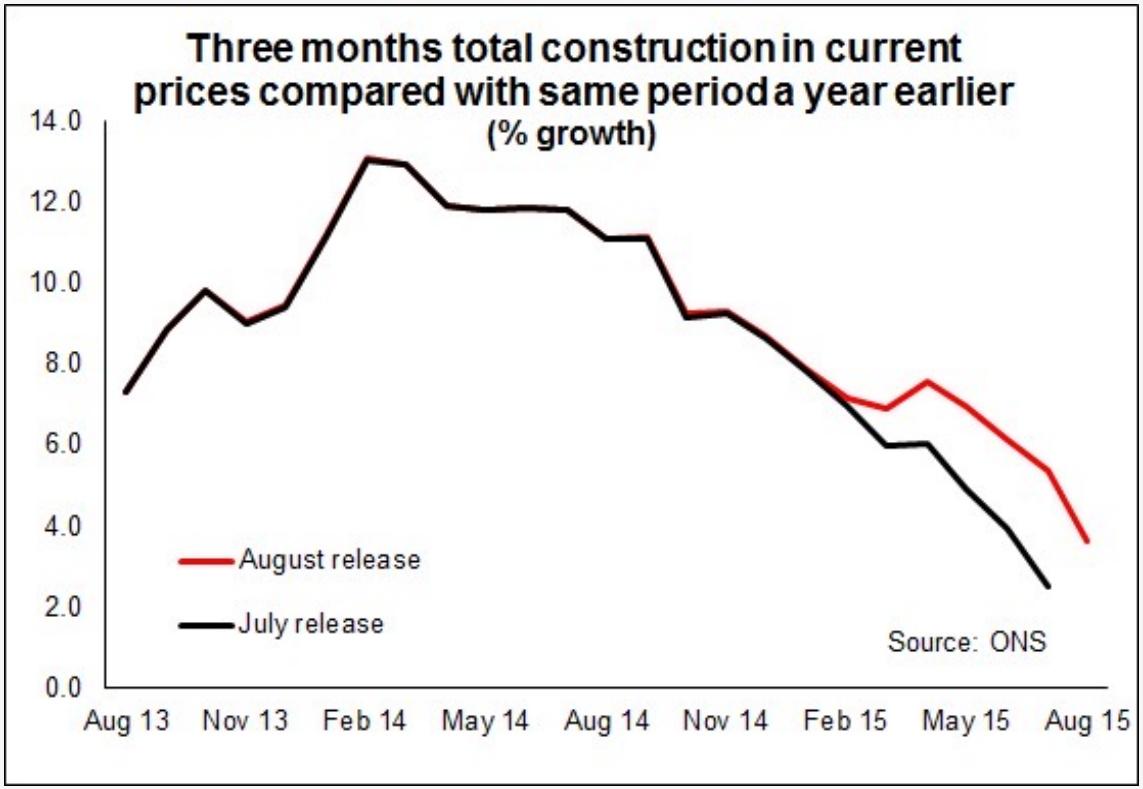
UK Statistics and ONS

- "An error was found in table 5 of the statistical bulletin for Output and New Orders in the Construction Industry, April 2015 and Q1 2015. The error concerns the GDP quarter on same quarter a year ago growth rates misquoted as a result of a spreadsheet error."
  - The revisions added £1.5 billion to turnover in the months March to July, about 2.4% more. Over £1 billion of the revisions were in the infrastructure sector, boosting estimated output by more than 10%.

- The ONS reallocated a major business from the services sector to construction (the firm's turnover could be £3 billion, but its name is confidential). The work had previously been allocated to services.

- Issues with ONS statistics became so serious they led to an inquiry in 2015 led by Professor Charles Bean from LSE (ex BoE).
  - Independent Review of UK Economic Statistics.

UK Construction Statistics

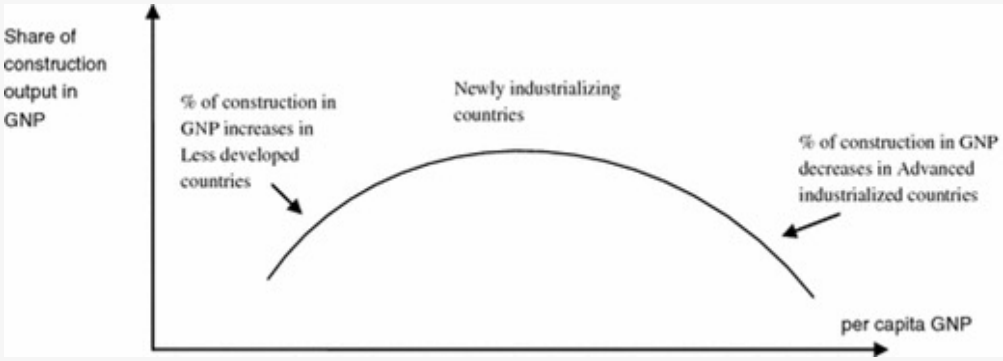


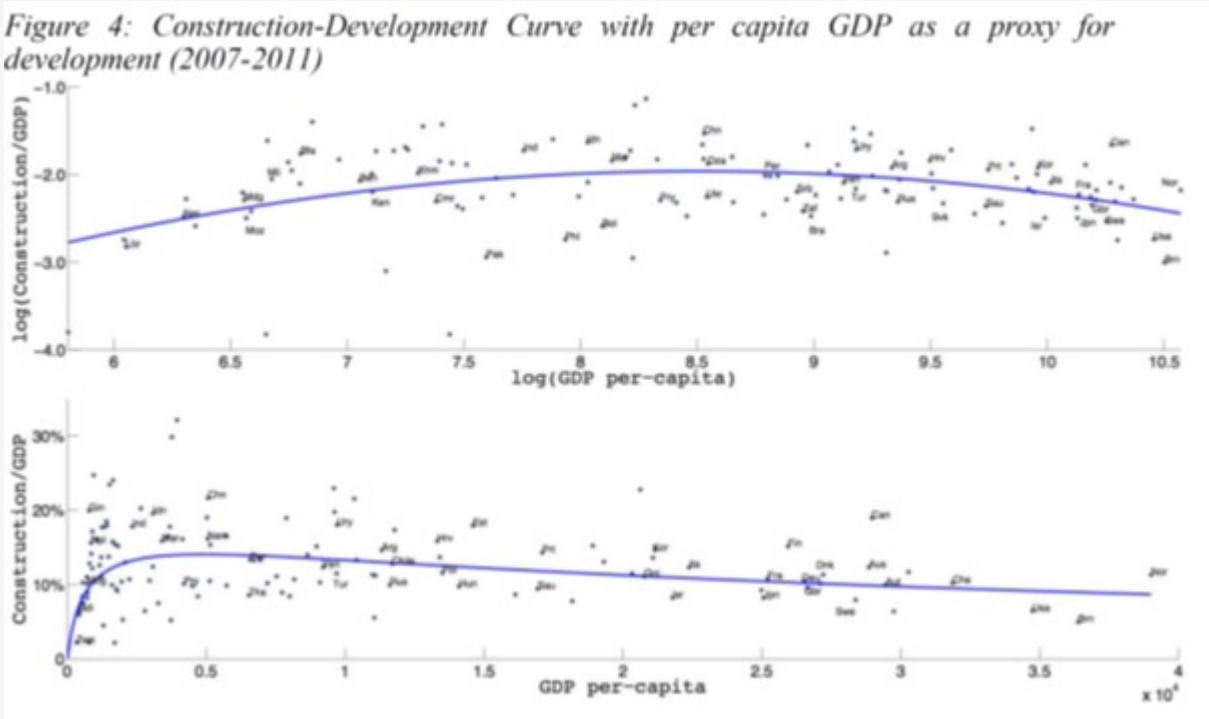
The chart shows the three months total of UK construction output and the total over the same period a year earlier. The black line is the original data from July, the revised red line was in the August release from the ONS a month later.

Data and Issues

- International comparisons:
  - Share of GDP and employment are affected by inclusions and/or exclusions from construction statistics.
- Contributions to growth:
  - Investment is the most variable component of GDP;
  - Construction is the most volatile part of Investment.
- Boundaries of firms, markets and industries:
  - Some construction work is not included in output;
  - Within NACE there is an issue with developers and contractors getting classified into the wrong category.

Bon Curve





Bon, R. 1992. The future of international construction: Secular patterns of growth and decline. *Habitat International, 16*(3), 119–128.

Girardi, D. and Mura, A. 2014. The Construction-Development Curve: Evidence from a New International Dataset, *The IUP Journal of Applied Economics*, Vol. XIII, No.3.

Construction and investment expenditure

GROSS FIXED CAPITAL FORMATION

Gross Capital Formation

- One of the insights of national accounting is that money not spent on consumption can be saved and spent on investment that enhances the economy's productive capacity:

- In the national accounts, investment is the purchase of machinery, software, infrastructure and buildings, and inventories. Together these are called gross capital formation (GCF). When changes in inventories is excluded, with only the purchases of buildings, structures, software and machinery included, the result is known as gross fixed capital formation (GFCF).

- This measures total expenditures on products intended for use in future production, "gross" means the expenditure is measured without deducting the consumption of fixed capital (the wear and tear).

Investment

- During revisions of the SNA in 1993 and 2008 intangible assets like software were included as investment in intellectual property, so GFCF now has two types of assets, material and intellectual.

- Material fixed assets are: dwellings (excluding land); other buildings and structures (excluding land); transport equipment; and other machinery and equipment. GFCF does not include the value of land because land is not a produced asset.

- Intellectual property fixed assets include: R&D; mineral exploration; computer software and databases; and entertainment, literary and artistic originals. Different countries have different approaches to these intangible assets and the inclusion of expenditure on software, R&D, trademarks and so on as investment.

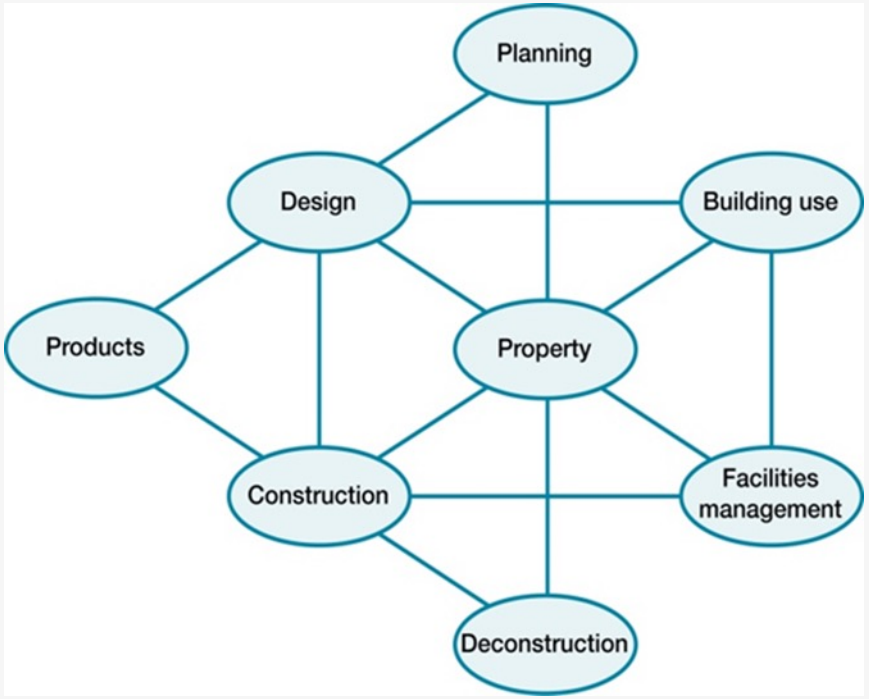
The Capital Account

Gross fixed capital formation Assets	Non-financial corporations	Financial corporations	General Government	Households
Dwellings				
Other buildings and structures				
Machinery and equipment				
Weapons systems				
Cultivated biological resources				
Intellectual property				
Costs of ownership transfer of non-produced assets				

GFCF is defined as the 'net acquisition of produced fixed assets', which are assets intended for use in the production of goods and services in the future (for more than a year). Net acquisitions means that GFCF deducts sales of fixed assets on the second-hand market from purchases of fixed assets, and produced assets were traditionally physical, material assets like buildings and machinery. Components of GFCF are found in the *Capital Account*, one of the supporting tables GDP is based on, across the four institutional sectors the economy is divided into by the SNA.

Country	Dwellings	Other buildings and structures	All construction	Machinery and equipment	Intellectual property
Austria	19.8	29.6	49.4	33.9	16.5
Canada	28.0	32.7	60.7	25.81	13.4
Colombia	16.5	46.5	63.0	23.8	1.3
Czech Republic	12.6	31.0	43.6	44.8	11.1
Denmark	22.5	23.8	46.3	32.92	20.8
Estonia	12.8	40.3	53.1	40.6	6.0
Finland	26.2	28.0	54.2	24.9	20.7
France	27.3	26.8	54.1	24.1	21.5
Germany	28.3	20.4	48.7	34.9	16.4
Greece	29.5	25.9	51.4	35.5	8.9
Ireland	26.7	23.3	50.0	28.7	21.3
Israel	28.9	19.8	58.7	30.8	20.5
Italy	25.8	25.6	51.4	35.2	13.2
Japan	14.8	30.6	45.4	28.4	20.6
Korea	15.2	38.6	53.8	30.7	15.5
Latvia	10.4	39.1	49.5	43.3	6.6
Netherlands	23.9	27.6	51.6	28.4	19.8
New Zealand	25.6	26.4	52.0	34.8	13.2
Norway	19.0	43.6	62.6	24.9	12.5
Portugal	22.7	35.1	57.8	30.2	10.7
Slovak Republic	11.1	33.6	44.7	44.8	7.7
Slovenia	13.4	35.6	49.0	38.3	12.2
Spain	30.9	30.2	61.1	28.6	9.9
Sweden	15.1	22.2	37.3	34.7	27.7
United Kingdom	20.1	33.2	53.3	25.9	20.4
United States	20.1	22.5	42.6	25.7	23.6

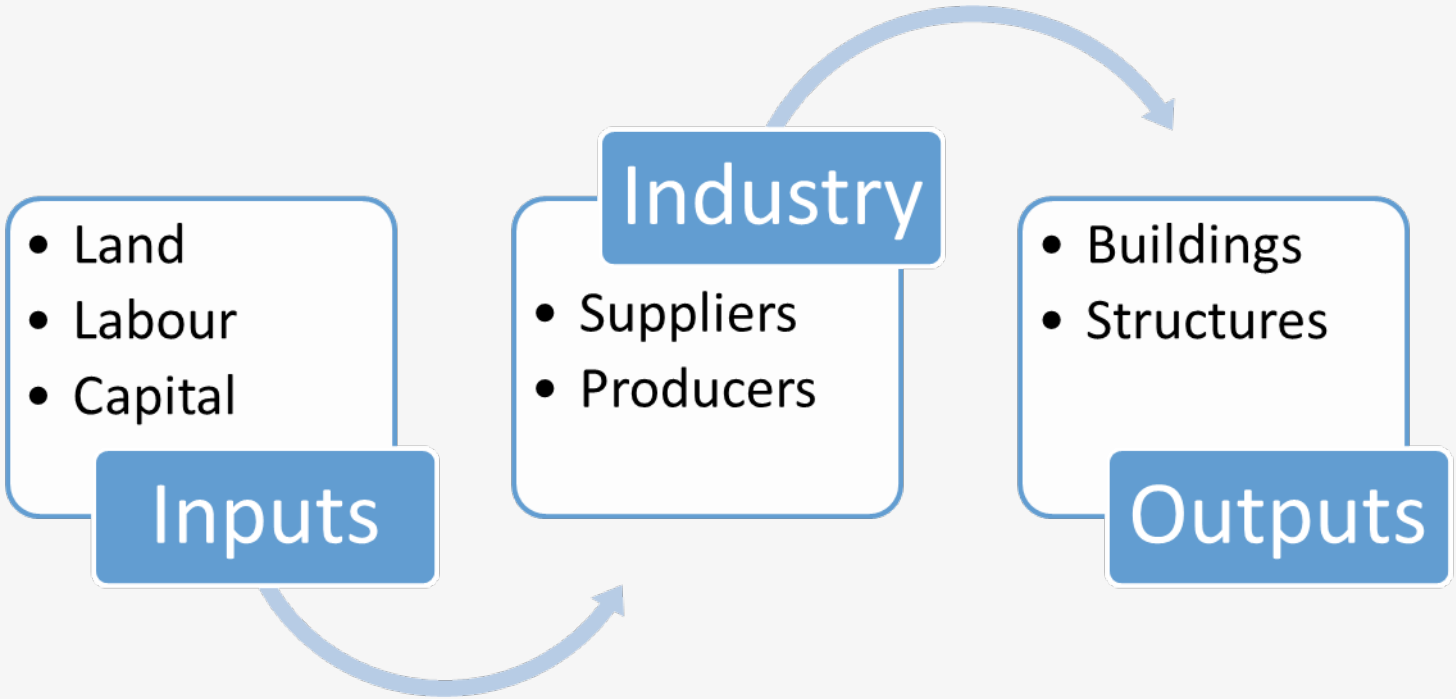
Source: ONS 2017: 13. The table shows average spend as a percentage of GFCF over the 10 years 1997 to 2017.



Broad and narrow definitions of construction

THE BUILT ENVIRONMENT SECTOR

Transforming Inputs into Output



Industries are defined as groups of firms with common characteristics in products, services, production processes and logistics, subdivided by the Standard Industrial Classification into four levels.

Boundaries

- Where are the boundaries of firms, industries and markets?

- This is a big issue in construction economics because construction output statistics exclude a lot of work, such as:
  - Buildings for own use by industry, e.g. retailers like Westfield that design and construct their own buildings.
  - Work done inside public sector organisations by their own employees, such as water and gas utilities.
  - Professional and technical services are outside construction.
  - Repair and maintenance is not counted.
  - DIY and informal building is not counted.

- Much of this missing output is captured in GFCF data, but not professional services.

Defining the Industry

- Within an industry competitors produce substitutes that are close enough that the behaviour of any firm affects the others, either directly or indirectly.

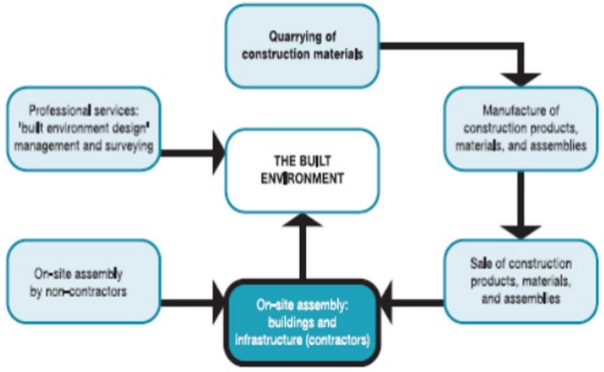
- Official statistics on the output of the construction industry capture on-site activities of contractors and subcontractors. However, construction links suppliers of a wide range of inputs into the built environment.

- These two views have been called broad and narrow, with the narrow industry defined as on-site work and the wider industry as the supply chain of materials, products and assemblies, plus professional services such as management, architecture, engineering design and surveying.

Broad Industry is Twice the Size

SIC	Industry	Turnover/% shares of total output		GVA at basic prices/% shares of total output		Employment costs/% shares of total output		Employment during year/% shares of total	
F	Construction	131,179	57	47,647	55	23,798	52	1,370,000	57
C	Quarrying	4,439	2	1,642	2	695	2	29,000	1
D	Manufacturing	40,948	18	15,265	18	9,044	20	465,000	19
G	Trade	24,228	10	5,135	6	3,019	7	155,000	6
K	Real estate, renting & business activities	30,207	13	16,814	19	9,247	20	399,000	17
	Total	231,001	100	86,503	100	45,803	100	2,418,000	100

Figure 3.1 Broad and narrow industry structures



Pearce, D. 2003. *The Social and Economic Value of Construction: The Construction Industry's Contribution to Sustainable Development*, nCrisp, London.

Australia 1998

Industry Segment	Total Industry Income $m	Total Industry Income %	Employment	Employment %
On-site services (trade services)	21,898	20	220,000	32
Building and construction project firms	34,250	31	108,000	16
Client services (engineering, technical, etc.)	8,607	8	102,000	15
Materials and product supplies	41,352	37	222,000	33
Machinery and equipment supplies	4,312	4	30,000	4
Total	110,419	100	682	100

de Valence, G. 2001. Defining an industry: what is the size and scope of the Australian building and construction industry? *The Australian Journal of Construction Economics and Building*, Vol. 1, No. 1, 53-65.

Types of Industry Clusters

- Industry clusters are groups of related firms of producers and suppliers in a defined geographic area that share common markets, technologies, worker skill needs, and which are often linked by buyer-seller relationships.

- Geographical – industries using the same resources in a location
  - Movies – Hollywood US, Bollywood India
  - IT – Silicon Valley CA., Silicon Alley NY., Silicon Glen Scotland, Bangalore India
  - Leather goods, spectacles and glasses – Italy
  - Health – Boston Route 91 US, Oxford England, Chenai India
  - Electronics – Guadalajara Mexico, Cordoba Argentina, Shanghai China
  - Finance – London England, New York US, Geneva Switzerland

- Vertical – a hub and spoke value chain from suppliers to end products
  - Automotive – Detroit US, Dusseldorf Germany, Turin Italy, Curitiba Brazil
  - Aerospace – Toulouse France, Seattle US

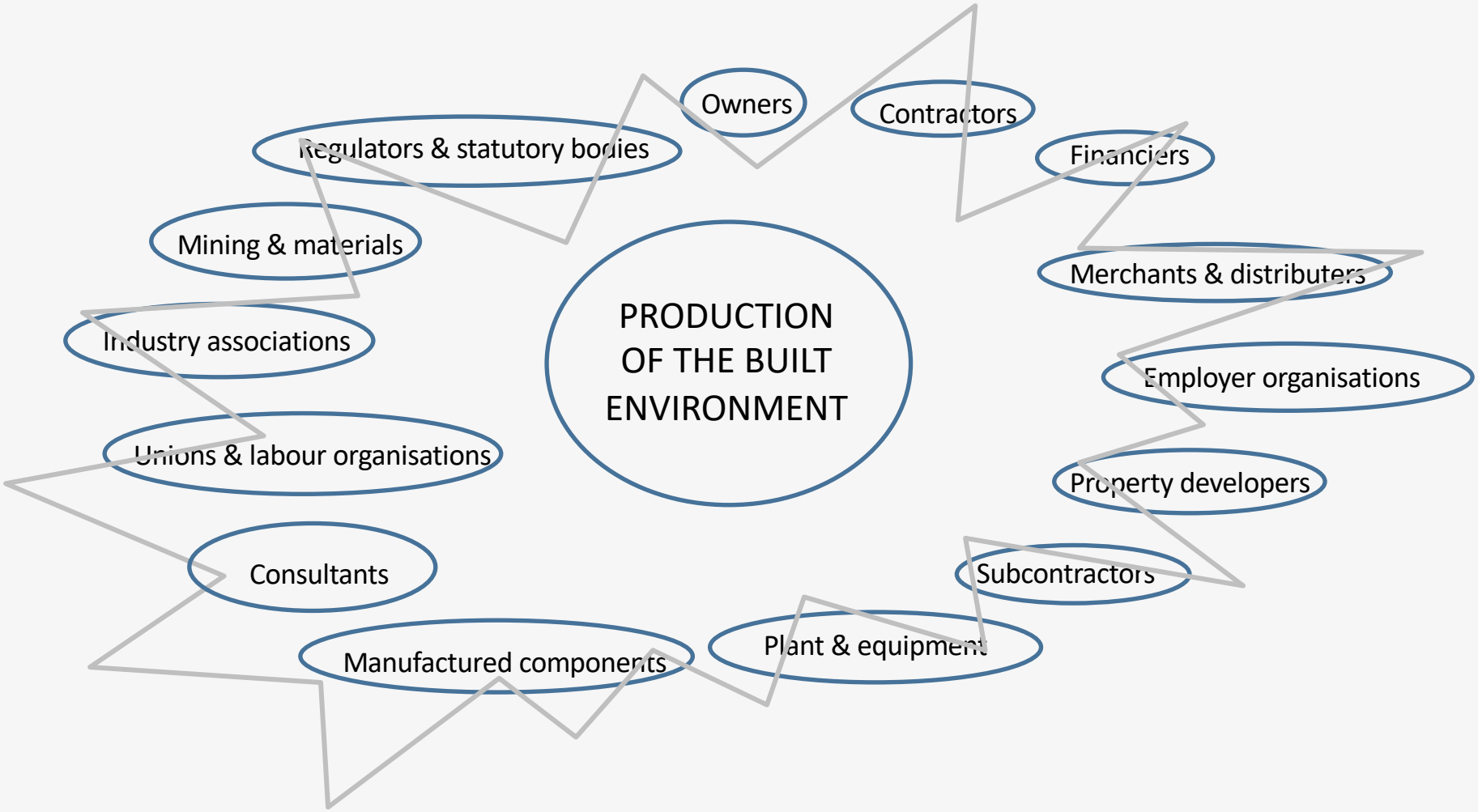
Geographically Distributed Clusters

- Some industries do not have central locations like the well known clusters in IT, wine, finance etc., or major hubs where production is concentrated like automobiles and aerospace. These industries are built around decentralised production, distribution and delivery networks that make their products widely available to clients and customers. Three examples:

1. Pharmaceuticals – a globally distributed industry, with countries combining some form of domestic production and imported supplies.
2. Electricity generation – brings many suppliers together in many locations.
3. Building and construction – the world's most ubiquitous industry, sharing the most widely used materials of wood, clay, glass, steel and concrete. Is this really a cluster?

Built Environment Industries

Too diverse to be a cluster, maybe an industrial sector



Industrial Sectors

- No precise meaning. Often used to describe a broad collection of firms with common characteristics, like ‘manufacturing’ or ‘the business sector’, or with a definable market. Examples are:

1. Defence – there is no defence ‘industry’ because suppliers come from many different industries like IT, aerospace and shipbuilding, but as a sector share resources and clients.
2. Tourism - brings together the contributions of industries like accommodation, tour operators and entertainment.

- The built environment sector is the collection of industries responsible for producing, managing and maintaining the buildings and structures that humans build. Two key requirements:
  - Industries need a direct physical relationship with buildings and structures;
  - Data on those industries’ output and employment needs to be available.

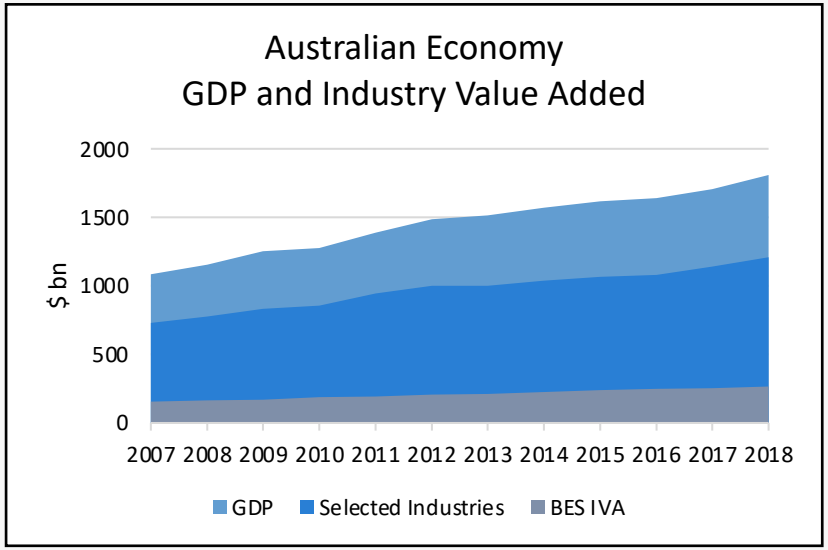
Industries Included in the BES

Supply industries	Demand industries	Maintenance industries
Non-metallic mining and quarrying	Residential property	Water, sewerage and drainage
Building construction	Non-residential property	Waste collection, and disposal
Heavy and civil engineering	Real estate services	Building and industrial cleaning
Construction services		Building pest control services
Architectural services		Gardening services
Surveying and mapping services		
Engineering design and consulting		
Manufacturing industries		

These 16 industries are included in the Australian BES. The BES is broad and extensive, so cannot be precise and exact. While the boundaries of industries and markets are important, in practice the SIC definitions are the starting point for the data used. The industries included are selected because they clearly have a direct physical relationship with buildings and structures, with the built environment.

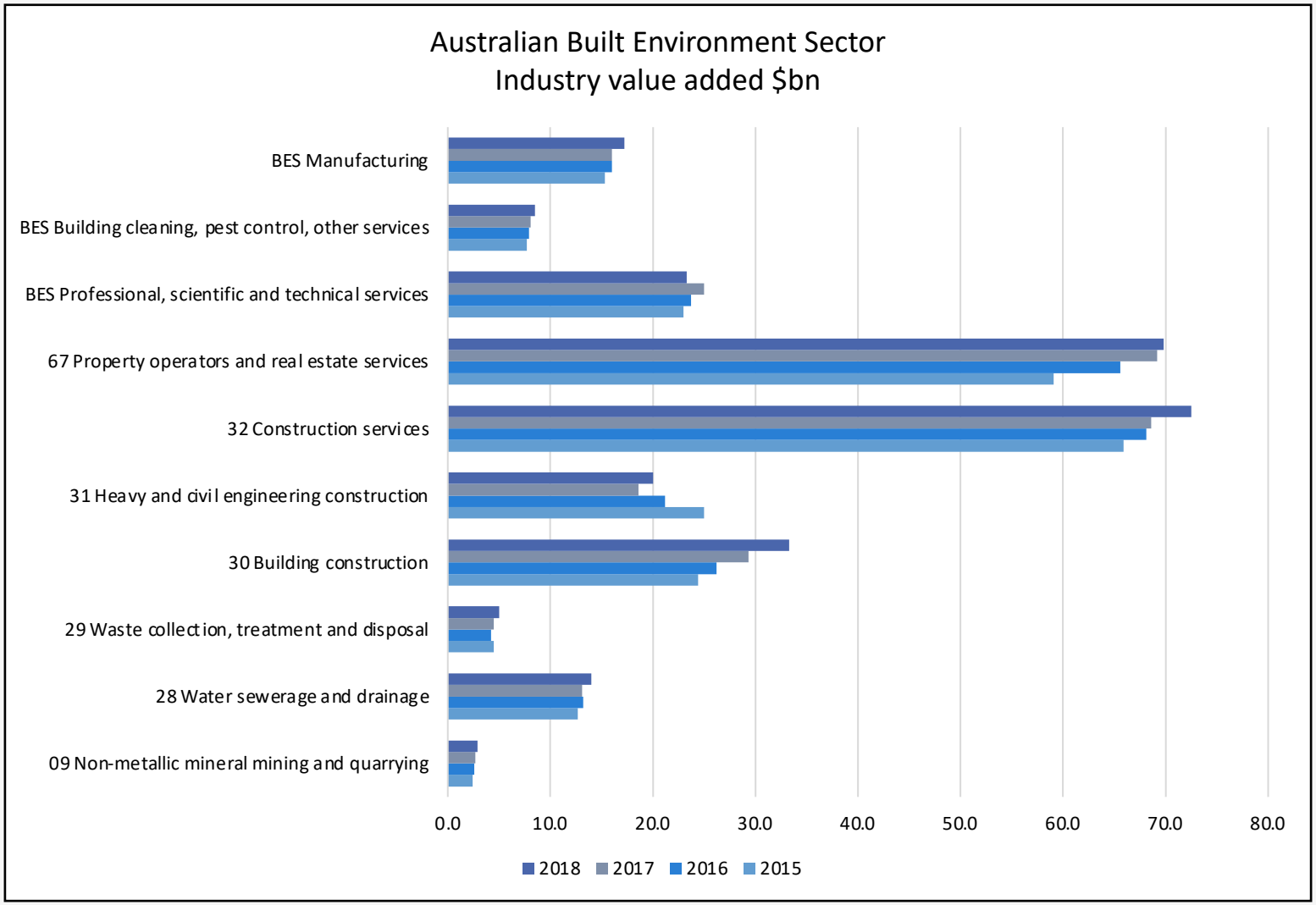
Economic Significance of the BES

2017-18	Employment	IVA $bn
Total Australian Built Environment Sector	2,101,000	266.5
Total All Selected Industries	11,177,000	1,209
Percent of All Selected Industries	18.8%	22.0%
Total Australia Employment and GDP	12,575,500	1,705
Percent of Australia total	**16.7%**	**14.7%**

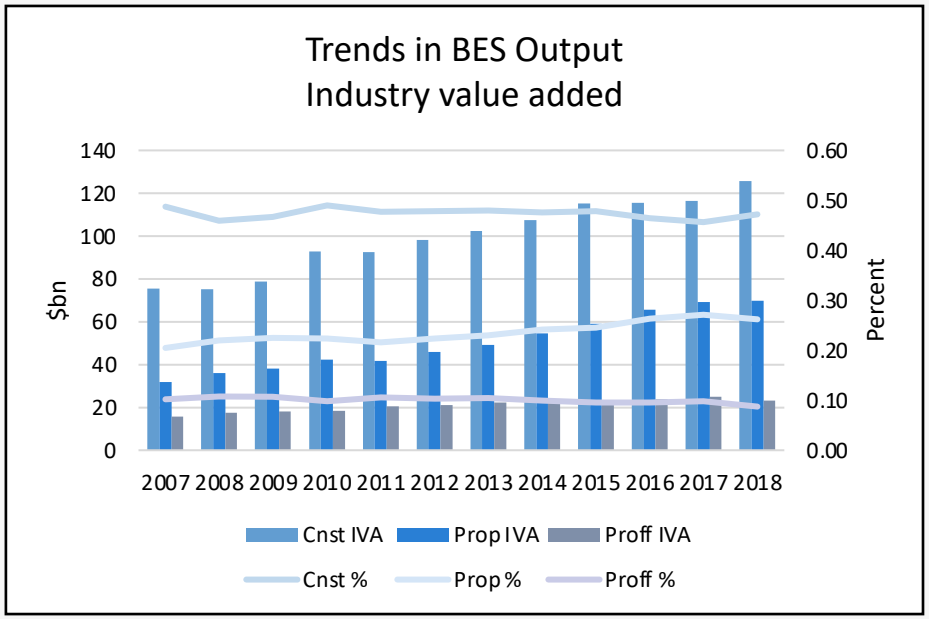


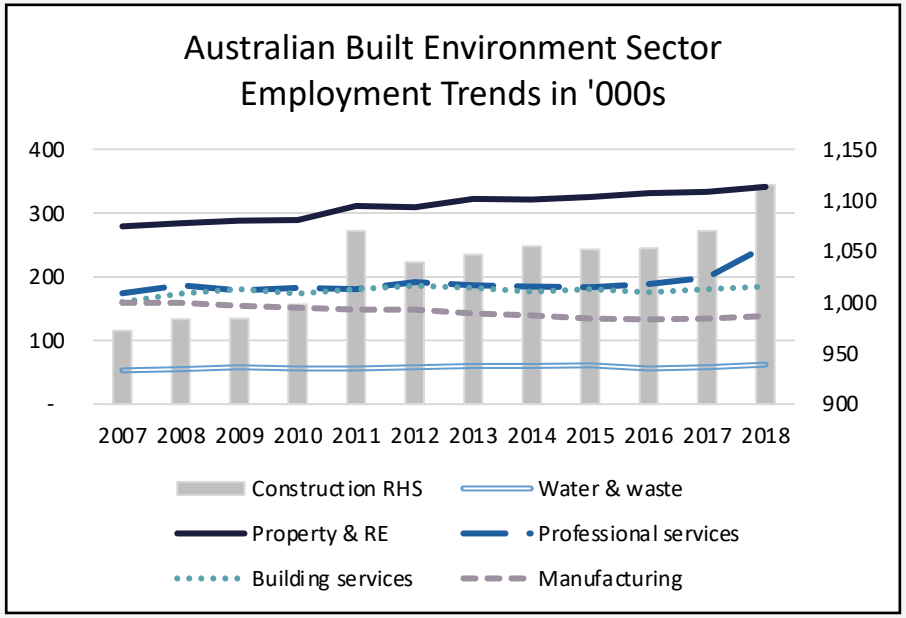
Australian Industry excludes the public sector but includes non-profits in industries like health and education, which are combined with private sector business to get a total for the selected industries, and thus measures the non-government part of the economy. As a share of total the BES was almost 15% GDP in 2017-18 and 17% of employment (adjusting for the 25% of GDP outside the *Australian Industry* sample).

BES IVA

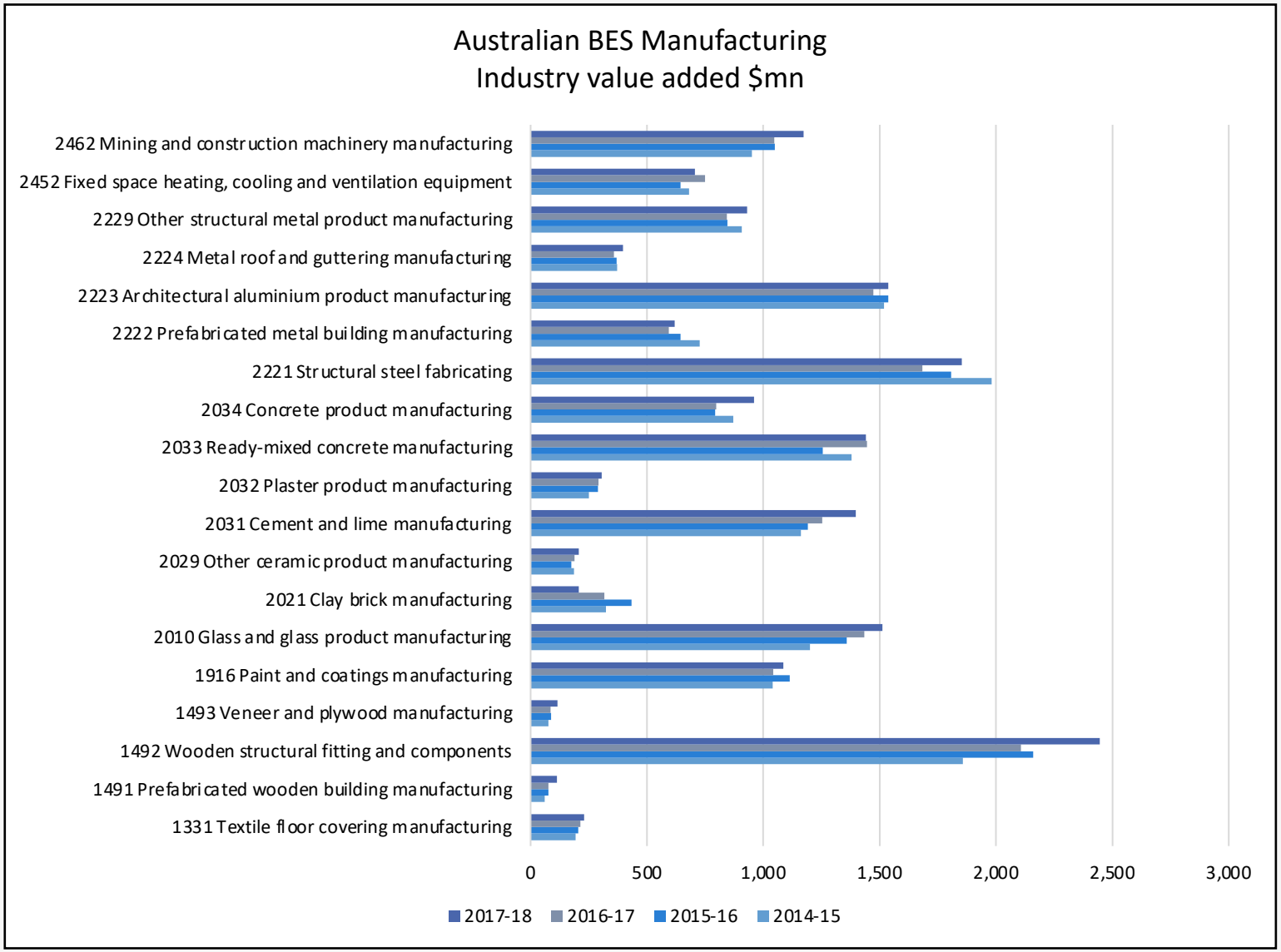

Australian Built Environment Sector
Industry value added $bn
BES Manufacturing
BES Building cleaning, pest control, other services
BES Professional, scientific and technical services
67 Property operators and real estate services
32 Construction services
31 Heavy and civil engineering construction
30 Building construction
29 Waste collection, treatment and disposal
28 Water sewerage and drainage
09 Non-metallic mineral mining and quarrying
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
2018
2017
2016
2015

Industry Trends





BES Manufacturing



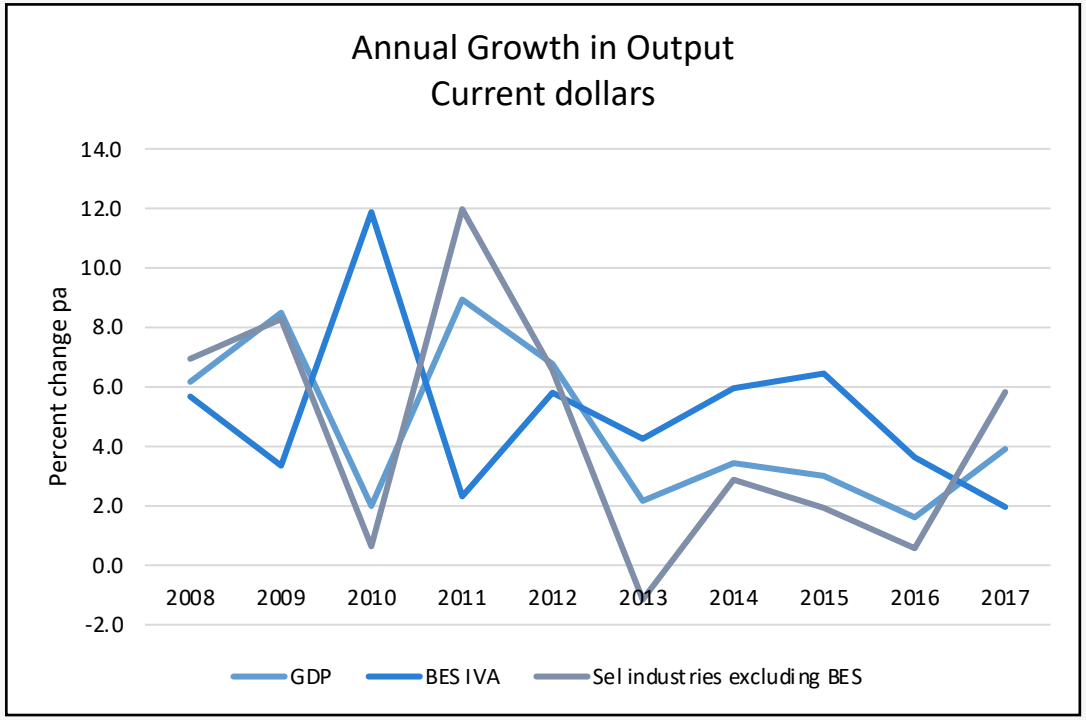
Macroeconomic Role

- The macroeconomic contribution of the BES to aggregate demand and employment is significant, as it is one of the largest industry sectors.

- It is also one of the most volatile components of the economy, with annual rates of growth or contraction greater, often much greater, than changes in GDP, making the BES a key driver of the business cycle. Through industry linkages and lags, slowdowns or pickups activity in can be strongly procyclical, exacerbating the peaks and troughs of the business cycle.
  - Because of the number of small firms found across the BES, the employment consequences of changes in activity levels are also significant.

- Changes in the composition of output of the BES is a leading indicator of future demand as current projects complete, through changes in the level of early stage project preparation work, and new projects join the pipeline.

BES as a Leading Indicator



Construction projects have many participants and extensive linkages with other sectors, measured through the industry's high multiplier effect of nearly 3. Through those linkages the impact of construction on other parts of the economy is much greater than the direct contribution. This gives the industry an important macroeconomic role, seen clearly in the effects of the Australian Government's fiscal response during the financial crisis in 2009-10.

Conclusion

- Changes in the composition of output of the BES is a leading indicator of future demand as current projects complete, through changes in the level of early stage project preparation work, and as new projects join the pipeline.

- All else equal, better data means better policy and, by the economic contribution of the various industries that comprise the Built Environment Sector can be measured. This is also important when considering the role of the industry and sector in the business cycle.

- Measurement is important, but so is choosing what to measure. In a time of rapid urbanisation and great social and environmental challenges, the built environment and city policies have become central issues in public policy.

- However, data follows the SIC format of output and employment by industry. In this view construction is just one of many industries, but the irony is that this is the industry responsible for building cities.