

The measurement of intangible assets in the healthcare and public sectors: a scoping review of current knowledge and an application to the NHS App

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Part of



Overview

- Definition of Intangible assets
- Why are they important?
- Why are they important in the Public Sector?
- Objective
- Methods
- Results
- Application to NHS App

What is an intangible asset?

- Intangible assets are usually defined, following the seminal Corrado, Hultens and Sichel (CHS) framework as non-physical, durable stores of value
- Examples: data, software, branding and organisational techniques
- Some (software, data, R&D) are already capitalised in the System of National Accounts, others (branding, organisational techniques) are treated as intermediate consumption

Why are they important?

- Intangible assets are highly synergetic, scalable, less rivalrous and appropriable than tangible assets and lead to knowledge spillovers → key to productivity growth
- Modern service-based, digitalised economies increasingly involve use of intangibles
 - In the UK private sector, intangible investment = tangible investment^{10,17}
- They are capital, their measurement is as important to understand the economy as more intuitive, tangible capitals

Why are they important in the public sector?

- UK healthcare productivity has been flat over recent years- improving it is crucial under the resource constraints we face^{4,18}
- Public sector productivity = the ratio of outputs to inputs → accurately measuring intangible capital—which can function as both—is essential for understanding productivity
- The recent NHS ten-year plan heavily emphasises the use of intangible assets through the analogue to digital shift, AI and the federated data platform
- Despite this, there are no regular estimates of intangible assets in the healthcare or public sector, unlike their private sector counterparts

Objective

We conduct a scoping review following PRISMA standards to answer three research questions

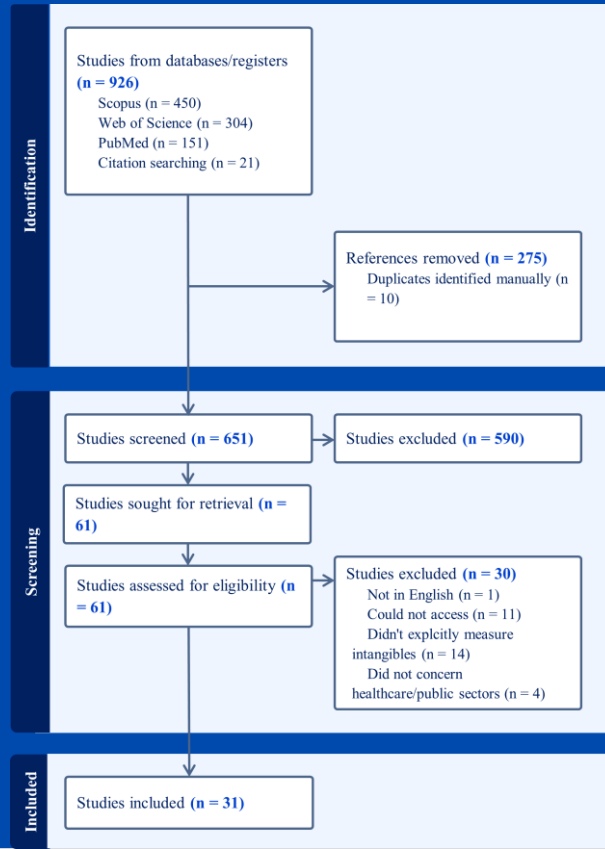
1. What methods are used to measure intangible assets in the healthcare and public sectors?
2. What are the specific challenges posed to measurement of intangible assets in the healthcare or public sector setting?
3. What would be the effect of including intangible assets in a measure of public sector productivity?

In light of our findings, we also propose an alternative valuation method using a worked example of the NHS App.

Review methodology

- The review follows PRISMA guidelines for scoping reviews
- We search PubMed, SCOPUS and Web of science
- Two reviewers independently screened studies and extracted data from them
- Inclusion criteria: 1) The publication must be free to access and in English; 2) The publication must concern the measurement of at least one intangible asset 3); The paper must concern healthcare or the public sector at large, excluding publicly owned corporations and government sponsored enterprises; 4) It must be from 2005-2025, so it is at least influenced by the CHS framework

Search results



- After duplicate records were removed, our search identified 650 research articles, 61 were considered for full text review, of which 31 met the inclusion criteria
- A key division emerged between intellectual capital - management literature – and intangible capital – economics and accounting literature

Intellectual capital vs intangible capital

- Intellectual capital contains only part of the spectrum of intangible assets: human capital, structural capital and relational capital
- Its boundaries were inconsistently defined
- They tend to use indicator or survey methods, resulting in ordinal valuations and focus on cross sectional, difficult to repeat, studies
- Intangible capital was more consistently defined following the CHS framework, used cardinal measures and focussed on longitudinal, easier to repeat, studies

Outline of intellectual capital definitions

Type of intellectual capital	Definition	Examples
Human capital	Knowledge, skills and experiences owned and used by individuals <i>(CHS methods would consider this as an asset of the individual not a firm and so part of labour quality, not capital)</i>	Professional competencies, specialised skills context-specific knowledge, leadership and managerial skills
Structural capital	Institutionalised knowledge and codified experience stored in databases, procedures, and the organisational culture	Vision, mission, values, strategic plan programs, tools and information systems, best practices & routines
Relational capital	Knowledge available through networks of relationships internal and external to the organisation	Patient/caregiver experiences, internal clinical-managerial relations, Contracts and partnerships with external organisations, brand/reputation

Source: Own adaption of Evans et al (2015) definitions of intellectual capital in healthcare organisations

Different categories of public and private sector intangibles within the CHS framework

Market Sector		Public sector	
Asset category	Asset	Asset category	Asset
Computerised information	Software	Information, scientific and cultural assets	Software
	Databases		Databases, including open data
Innovative property	R&D		Basic and applied science research, industrial and defence R&D
	Entertainment and artistic originals		Cultural and heritage, including design
	Design		Mineral exploration
	Mineral exploration	Societal competencies/social infrastructure	Brands
Economic competencies	Organisational capital (OC) (managerial and purchased)		Organisational capital (OC) (professional/managerial and purchased)
	Brands		Function-specific human capital
	Firm specific human capital		Schooling produced human capital

Source: Own adaptation of Corrado et al (2016) and Corrado et al (2005)

RQ1: What methods are used to measure intangible assets in the healthcare and public sectors?

- We identify three methods
 1. Survey based methods, used in 39% of identified studies
 2. Indicator based methods, used in 35%
 3. CHS (national accounts style) methods, used in 42%

RQ1: Survey based Methods

- Respondents are asked questions on the level and importance of intangible assets at an organisation, results are collated into an index
- These methods are inconsistent, with no standardised questions or indexation
- Results are ordinal, lack external validity and give results in non-common units → lack of comparability
- It is questionable whether respondents can accurately assess intangible assets⁹

RQ1: Indicator Methods

- These methods use proxy data points to indicate the level of a given asset
 - E.g. training expenditure per employee, size of data holdings per firm
- Indicators are somewhat more objective than survey methods
- They struggle to capture quality as well as quantity, and objectivity is reduced when they attempt to
- They are not standardised and give results in non-common units → lack of comparability
- In short, neither survey or indicator methods are of much use to a national accountant

RQ1: CHS type methods

- Value assets at their market purchase price if purchased from external source
- When assets are produced 'in-house', they are valued using the sum-of-costs method (i.e., the net present value of past investment in an asset)

$$K_t = \sum_{j=0}^{T-1} d^j I_{t-j} + d^T K_{t-T}$$

Equation summarising the sum-of-costs method, where K is capital, I is investment, d is 1 minus the depreciation rate and j is the iteration index

RQ1: CHS type Methods

- Methods are consistent and results are in monetary units → Comparisons are easy and valid and enable their use in national accounts
- Market price method is appropriate where a fair market exists. But this isn't always the case in public sector purchases
- Sum-of-costs method uses adjustment factors (e.g. time use and capitalisation rates), usually taken from the private sector due to lack of evidence
- Relies on neo-classical assumptions that don't hold for public sector intangibles: i.e., constant returns to scale, sufficiently flexible capital supply and no monopoly power⁸

An example: the NHS App

- Imagine a scenario where there are two NHS Apps, A and B
- Both have similar development, functionality and purpose, but for some exogenous reason A serves twice as many users as B
- The sum-of-costs method would value them similarly - but they clearly have different value
- The NHS App doesn't meet the necessary conditions for the sum-of-costs method

RQ2: What are the specific challenges in measuring intangible assets in the public sector setting?

- **Intellectual capital literature**

- Broad consensus that area is under researched compared to the private sector
- Politicisation, knowledge intensiveness and higher degree of intangibility in the public sector make measurement challenging - but how is underexplored

- **CHS literature**

- The main challenge, that assets are often produced and used in house, is common to public and private sectors
- Relatively minor differences between public and private sector methods but some assets are unique to the public sector
- There are limited estimates of adjustment factors for the private sector

RQ3: What would be the effect of including intangible assets in a measure of public sector productivity?

- Unlike private sector, there is very little focus on productivity
- No significant effect on existing labour productivity and TFP statistics- they don't fully include the public sector
- Corrado et al (2016) suggest imputing a return to capital to overcome this, but evidence for this is limited
- No consideration of the effect of capitalisation on Atkinson¹ style Public Service Productivity measures

Conclusions

- This scoping review summarised the current state of measurement of intangible assets in the public sector
- It identified three methods: survey, indicator and CHS methods. All of which have distinct flaws
- Measurement in the public sector is not massively different to measurement in the private sector
- But has received less attention partly due to the challenges of measuring public service inputs and outputs¹

An alternative: the Income method

- In light of our critiques, we suggest exploring the potential use of the income method
- It values assets as the expected net benefit/income from the asset
- Like the sum-of-costs method, it gives answers in comparable, monetary units but doesn't require the same restrictive assumptions
- We apply this to the NHS App to value it in 2022/23

An alternative: the income method

- The App is conceptualised as a labour-saving device; it allows labour inputs to be reduced or reallocated to other productive tasks
- We treat the App as an input to the healthcare system, in an Atkinson public service productivity method. Any quality-based, output effects are considered separately as an output of the whole system

$$NPV \text{ of expected benefits} = \sum_{t=1}^{T=3} F_{o,t,a} T_{o,f} W_{o,t} s^t$$

The income method, where F is the number of tasks (functions) of type a completed by occupation o in time t , T is the time it takes to complete a task f , W is the deflated wage of occupation o in time t and s is the discount rate, the social rate of time preference

- We use two datasets- NHS App activity which covers the whole period but for limited functions, and NHS App benefit data which covers all functions but for only some of the period. Missing data is forecasted, limiting the accuracy

An alternative: the income method

- We also produce a sum-of-costs valuation for comparison, using data from various NHS App development contracts

$$K_t = \sum_{j=0}^{T-1} d^j I_{t-j} + d^T K_{t-T}$$

*Equation summarising the sum-of-costs method,
where K is deflated investment into the App, I is investment, d is 1 minus the software depreciation rate and j is the iteration index*

- In both methods, we use the software depreciation rate of 0.33 (taken from the CHS framework) and the generic GDP deflator.

Applied example: Results

Method	Income method (NHS App activity)	Income method (NHS App benefits)	Sum-of-costs method
Value in 2022/23	£73,742,395.37	£195,976,564.31	£50,582,088.35

- Income method valuation is between 46%-287% higher than sum-of-costs
- This suggests the sum-of-costs may be a lower bound
- The large increase in value from the sum-of-costs method would have significant implications for productivity and GDP calculations so should be treated cautiously

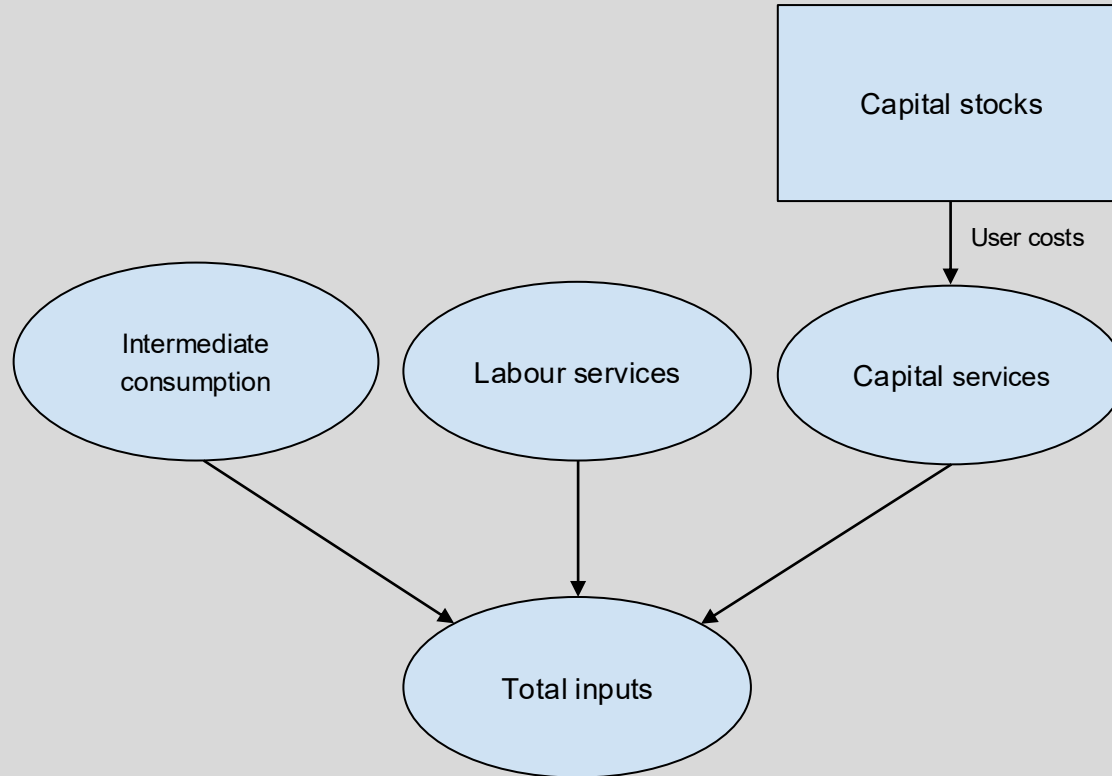
Applied example: the NHS App

- What is the point of this?
- Theoretically, sum-of-costs and income methods should give the same results
- As they give such different results it suggest one or both are inappropriate
- Whilst our income method is not accurate, and is harder to implement in practice for many assets, its clear the sum-of-costs assumptions are not appropriate

NHS App as an output?

- In the example, we treated the NHS App as an input
- But it also has direct effects on patients- convenience, easier access to services and data etc
- These quality-based, output effects are considered separately as an output of the whole system in an Atkinson productivity method
- But represent something that is perhaps not fully captured in current methods

Aside: effect on ONS Public Service Productivity statistics



Aside: effect on ONS Public Service Productivity statistics

- The effect of including currently non-capitalised intangibles or using the income method that increases the value of assets would be to increase capital stocks and services and to potentially decrease intermediate consumption
- But as PSP is calculated from growth in inputs/outputs, not levels the effect is ambiguous
- I would be interested to hear any thoughts

Future work

- Address whether the sum-of-costs method is appropriate to measure intangible assets in public sector and investigate the potential use of the income method
- Create better estimates for the sum-of-costs adjustment factors
- Disaggregate specific measures of intangible assets in public service productivity measures
- Explore the effect of capitalising more intangible assets/using the income method on productivity measures
- Investigate the measurement of public sector intangibles as outputs

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