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The use of system dynamics in a strategic review of the English dental workforce

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Abstract

This paper describes how system dynamics (SD) was used in 2013 on a strategic review of the English dental workforce. The project was commissioned by Health Education England (HEE) through the Department of Health (DH) with the purpose of projecting and analysing the future supply of, and demand for, the English dental workforce through to 2040. The project was driven by the need to provide sustainable, high quality dental services in a complex and evolving environment given recent fluctuations in dental student numbers. The system dynamics approach meant that robust, evidence-based supply and demand models could be created to test potential policies and their impact.

Key Words: System dynamics, workforce planning, dentist, healthcare, strategy development

1. Introduction

This paper describes how system dynamics (SD) was used in 2013 on a strategic review of the English dental workforce (CfWI, 2013a). The project was driven by the need to provide sustainable, high quality dental services in a complex and evolving environment given recent fluctuations in student numbers. The original dental schools have been consistently exceeding their quotas since 2007, with the average annual intake exceeding the target by a total of 75 students across England (CfWI, 2013a). The Health and Social Care Information Centre's Dental Statistics for England 2011-12 (HSCIC, 2013a) reported that there were 22,920 dentists providing primary care NHS dental services in 2012.

The project was commissioned by Health Education England (HEE) through the Department of Health (DH) with the purpose of projecting and analysing the future supply of, and demand for, the English dental workforce through to 2040.

The stated objective of the DH is to “lead, shape and fund health and care in England, making sure people have the support, care and treatment they need, with the compassion, respect and dignity they deserve” (DH, 2014). The role of HEE is to “ensure that the shape and skills of the future health and public health workforce evolve to sustain high quality outcomes for patients in the face of demographic and technological change” (HEE, 2014).

The project supported HEE, DH and the English Department for Business, Innovation and Skills (BIS) in policy decision-making to secure the dental workforce of the future and, specifically, the number of future dental students required. The project built on a review of the medical and dental student intakes carried out by the CfWI for the Health and Education National Strategic Exchange (HENSE) review group in 2012 (CfWI, 2012a).

The project was carried out by the Centre for Workforce Intelligence (CfWI) with support from Decision Analysis Services Ltd (DAS). The CfWI is an independent agency working on specific projects for the Department of Health and is an operating unit within Mouchel Management Consulting Limited. The CfWI is the UK's national authority on workforce planning and development, providing advice and information to the health and social care system. The aim of the CfWI is to produce quality intelligence to inform better workforce planning, in order to improve people's lives. The CfWI are supported by DAS who provide specialist system dynamics consultancy. DAS is a team with a shared vision of solving strategic challenges facing government and industry decision makers using systems modelling and simulation methods.

The CfWI's *Robust Workforce Planning* approach (CfWI 2014a) was adopted for this project. This is a method for identifying potential future issues that need to be addressed by workforce planners. It allows them to assess the impact of workforce policy options and reduce risk. The first stage is to think about what health and social care may look like in the future, including the workforce needed to provide it. The focus is then on policies to deliver the required workforce, and test them across a range of futures defined by a set of scenarios. This allows robust decisions to be made that recognise the uncertainty of the future.

Central to the approach are system dynamics (SD) models that calculate workforce supply and demand – in this project the dental workforce. The models are grounded in empirical

data and evidence. The models enable analysis against a range of potential futures and policy interventions. The models also allow the rapid assessment of the implications of scenarios and policies across the whole of the dental training systems and workforce.

This paper describes the overall approach adopted in the project and the SD modelling work undertaken to model the future supply and demand of dentists in this project.

1.1. Contents

Section 2 describes the challenge of health and social care workforce planning and provides detail surrounding the delivery of dental services in England.

Section 3 provides an overview of the *Robust Workforce Planning* framework, which is used by the CfWI to inform strategic workforce planning decisions. The role of system dynamics in the framework for this particular project is described.

Section 4 describes the systems dynamic model that was developed during the project to provide projections of future supply and demand of dentists.

Section 5 describes how the model was used in the strategic dental review.

Section 6 discusses the impact of the system dynamics modelling and the next steps for the application of system dynamics in the CfWI.

2. The challenge – Planning the future dentistry workforce

This section describes the challenge of health and social care workforce planning and provides detail surrounding the delivery of dental services in England.

2.1. Introduction to health workforce planning

Effective workforce planning has been described as ensuring “The right people, with the right skills, in the right places, at the right time” (Taylor, 2005). This is a challenge in health care due to a complex mix of staff and staff functions, the large geographic area that is covered and the changing policies that influence the supply and demand of care. In addition the healthcare workforce in England is large. As of September 2012, there were 1,358,295 staff in the NHS Workforce (HSCIC, 2013c).

The risks of poor workforce planning are to put patient lives at risk, increase morbidity, and the need to spend large sums of money to correct sub-optimal systems. Employees can suffer from the stresses of understaffing, or in the case of oversupply, livelihoods can be put in jeopardy if jobs are not available. To mitigate risk it is important to have foresight of the key issues, and flexibility within the workforce and the training pipeline (i.e. the stages required prior to entering the workforce) to adapt when necessary.

Workforce planning is made more difficult by complicated training career pathways. There are many routes through training, different flows and transitions between these routes, and

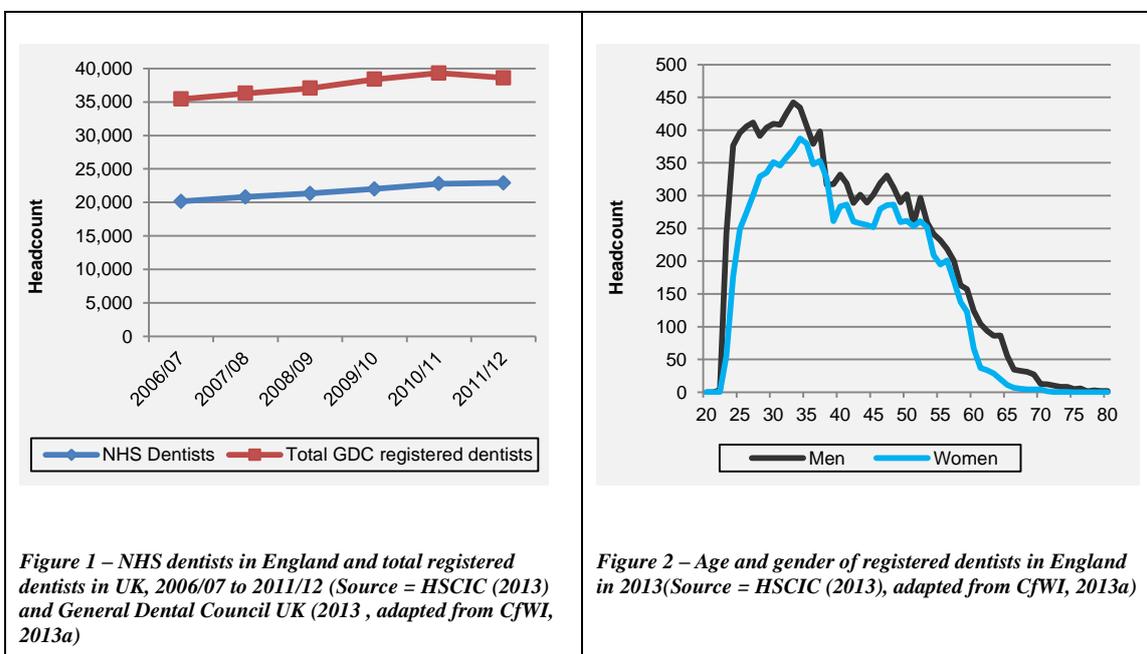
migration in and out of England and the UK. Behaviours of the workforce also vary by age, gender and profession. The long timescales for training make it hard to measure the impact of policy changes and to make corrections. The inertia, delays and complex influences in the system mean that modelling is complicated. In addition there are the complexities of estimating the requirements of the future health needs of the population.

2.2 The dental workforce

Dental services in the UK are provided by a multi-professional workforce that includes dentists, dental nurses, dental hygienists, dental therapists, orthodontic therapists, dental technicians and clinical dental technicians. The focus of this project was dentists. Dentists currently make up 37% of the total dental workforce (General Dental Council, 2013).

In the UK, dentists must be on the General Dental Council (GDC) register in order to practise. In 2013 there were 38,832 UK registered dentists. Dentist may also provide non-NHS services. The Health and Social Care Information Centre's Dental Statistics for England 2011-12 (HSCIC, 2013a) reported that were 22,920 dentists providing primary care NHS dental services in 2012. There has been a gradual, but steady growth in the number of dentists since 2006/2007, as shown in Figure 1.

In addition there have been significant changes to the composition of the dentist workforce. For example, there has been an increase in the number and proportion of women in the workforce. Figure 2 gives the composition of dentists on the 2013 register in terms of age and gender. Understanding the workforce composition is important as workforce attributes, such as attrition, retirement and part-time working vary significantly by age and gender.



Further details regarding the delivery of dentistry in England are given in the CfWI review of the workforce (CfWI, 2013a).

2.3 Training to become a dentist

Dentists are highly skilled workforce that undergoes structured training in order to practise. Undergraduate dental education lasts five years. Completion of undergraduate training permits entry to the GDC Register. Following this, mandatory dental foundation training (formerly known as vocational training) is needed for new UK graduates wishing to work in NHS primary care. This training is a minimum of one year full-time (or a part-time equivalent). Training is spent in primary care, providing NHS general dental services. Post-foundation training is undertaken to develop basic skills and experience further, and (in some cases) prepare for specialist training (CfWI, 2013a).

The numbers of students undertaking undergraduate training in dentistry has been increasing over recent years. Figure 3 provides the changes in student intake, and Figure 4 the changes in total numbers of undergraduates.

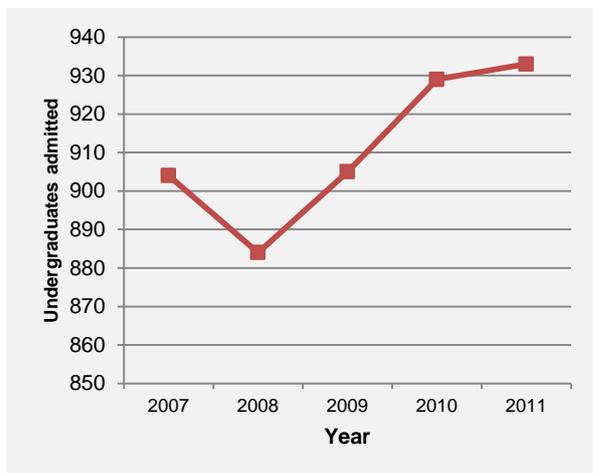


Figure 3 – Annual dental undergraduate students admitted between 2007 and 2011 (Source = HEFCC, adapted from CfWI, 2013a)

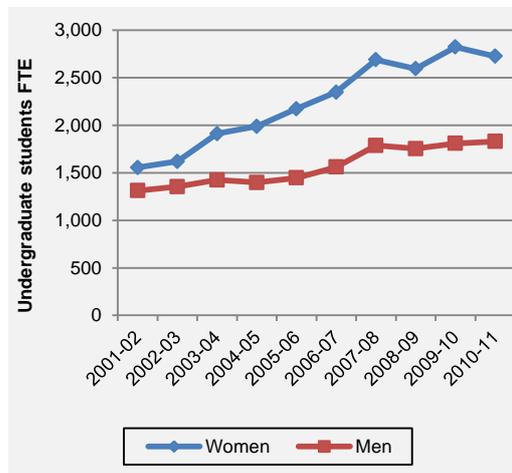


Figure 4 – Numbers of undergraduate student FTE in dentistry by gender from 2001-02 to 2010-11 (Source = HEFCE (2012) adapted from CfWI, 2013a)

Modelling the entrants of new dentists to the workforce is complicated as not all students who start training complete training, some take longer to complete training (for example as a result of resitting or part-time education), and of those that complete training some may not enter the workforce at all or may join the private sector.

2.4 The purpose of the review

The purpose of the review was to support the provision of training for the right dental workforce blend to meet the future needs of the population. This includes the wider use of all members of the dental team, what impact that will have on the need for trained dentists and how it will inform investment decisions on dental student intake. The dental team includes all members of the dental workforce, such as dentists, dental nurses, dental hygienists, dental therapists, orthodontic therapists, dental technicians and clinical dental technicians.

This project built on a review carried out in 2012 on the medical and dental workforces (CfWI, 2012a). The outcome of that review was that the HENSE review group recommended that “There should be another review of dental school intakes in 2013 (for 2014 intakes) following further work on the data on which such a review should be based – followed by a 3 year rolling programme of further reviews.” This paper describes the model used for the 2013 review, which was significantly improved from the 2012 review.

3. CfWI’s Robust Workforce Planning framework applied to the dental review

The CfWI has developed a workforce planning approach that recognises the complexity of factors influencing demand and supply and the intrinsic uncertainty of the future. This framework is referred to as the *Robust Workforce Planning* framework (CfWI 2014a). The key benefits of this approach are to support longer-term planning, here looking out to 2040; to support more robust decision making, taking account of the uncertainties of the future; and to help decision makers be more alert to emerging risks as the future unfolds. The approach has already been applied to a number of medical workforces, including pharmacists, doctors, General Practitioners, and psychiatrists.

The high-level framework is illustrated in Figure 5. The framework consists of four linked stages, the outputs from each stage feeding into the next. A major feature of the framework is the high degree of stakeholder involvement, which is critical to arrive at a shared view of future challenges, and in making policy decisions.



Figure 5– Robust Workforce Planning framework (CfWI 2014a)

The *Robust Planning Framework* was applied during the strategic review of the dental workforce. The stages are described below, along with specific details regarding the review. In order to carry out the review as efficiently as possible aspects of the 2012 dental review (CfWI, 2012a) were utilised.

3.1 Stage 1 - Horizon scanning

Horizon scanning explores the potential challenges, opportunities and likely future developments that could influence workforce planning. These include technological, economic, environmental, political, social and ethical (TEEPSE) influences on an unfolding future. Some of these influences may be viewed as predetermined, such as an ageing population, and some may be more uncertain, such as technology advances.

Horizon scanning involves desk based research and interviews with experts. A web site is used by the CfWI to collate expert opinions and present key factors¹. It was not necessary to carry out the Horizon Scanning stage specifically for this review as the insights from a previous study (CfWI, 2012a) from 2012 were still valid and were used to inform this review.

3.2 Stage 2 – Scenario generation

Scenario thinking focuses on how the future might evolve (Van der Heijden et al, 2002). Scenarios are essential for workforce planning since it is not possible to predict the long-term future accurately. Scenarios are particularly useful since a range of plausible futures can be generated and demand and supply projections made. Workforce plans can then be assessed against the scenarios for robustness. A series of scenarios describing how the future might evolve for the dentist workforce were developed for the 2012 study (CfWI, 2012c).

The focus for this study was to producing supply and demand projections for two scenarios. A ‘principal projection’ (or ‘expected future’) supply and demand, informed by a Delphi panel exercise, including the use of data sources and trends in oral health. This was compared with a ‘baseline’ extrapolation or ‘nothing changes’ projection.

The principal projection was informed by the previous horizon scanning research and through the use of the Delphi process (Dalkey & Helmer, 1963) to quantify key workforce supply and demand variables. In the Delphi process experts make quantitative judgments and share the reasoning behind them over several rounds to decrease uncertainty and refine the values. The Delphi process offers a method in which intrinsically uncertain values can be systematically generated and tested.

Fifteen stakeholders from across the dental system participated in two rounds of Delphi in July 2013. The Delphi questions focussed on the values of uncertain supply and demand parameters at 2025 and 2040.

¹ www.horizonscanning.org.uk

3.3 Stage 3 – Workforce modelling

The purpose of workforce modelling stage of the dental review was to project the expected demand and supply, and then enable further analysis to be carried out with respect to the outcome of different policies. System dynamics modelling is the preferred modelling tool for the CfWI since it is most appropriate to complex systems with feedback, like health and social care workforce planning, and can easily be extended or revised to address additional issues as they arise (CfWI, 2014d).

A SD model was developed for the dental review carried out in 2012, however this model required significant structural revisions and updates to the data and modelling assumptions for this review. The final SD model used for the 2013 review is described in Section 4.

3.4 Stage 4 – Policy analysis

Policy analysis focuses on analysing future uncertainties and the impact of policy options, and presenting the findings. By considering multiple future scenarios, different options can be tested to see which one is the most robust. There will be some which lead to favourable outcomes across all futures and others where the outcome is less clear. In these situations the relative probability of scenarios may need to be assessed, and scans made for signals that might indicate a particular scenario unfolding.

The SD model was used as a tool to quantify the impact of future policy options on the dental workforce. A number of different policy options, such as changing student intakes and changing the skill mix² for the delivery of dental services. Some examples of the policy analysis are given in Section 5. A full description of the policy analysis carried out using the model is given in CfWI, 2013a.

4 Dentist workforce system dynamics model

This section describes the *Dentist Workforce model*, a systems dynamics model that was developed to provide projections of the future supply of, and demand for dentists. This section describes the approach adopted to develop the model and the model itself.

4.1 Development approach

The CfWI have adopted a structured approach to model development (CfWI, 2014d). This approach is formalised in a best practise guide that lays out the development stages and expectations for the outcomes of each stage. The process, which is illustrated in Figure 6, is consistent with previous development methods presented by authors such as Sterman (2000), Keating (1999), Randers (1980) and Forrester (1961). The approach is also

² Skill mix refers to the ratios of different staff types used to deliver a service.

consistent with the recommendations of the MacPherson review of Government analytical models (MacPherson, 2013).

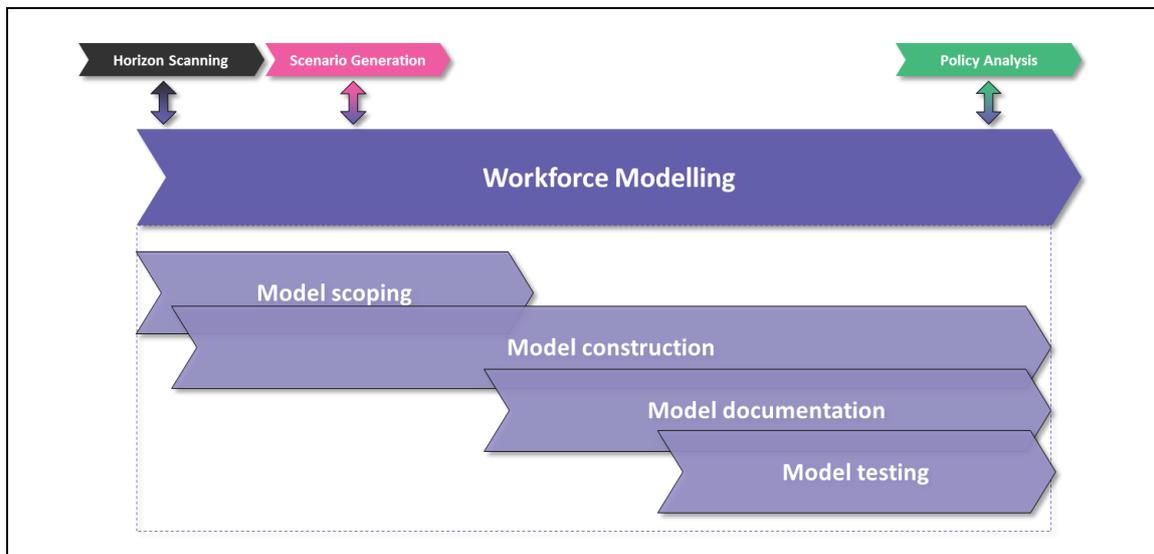


Figure 6 - The approach adopted by the CfWI to developing system dynamics based workforce models (CfWI, 2014d)

The model development process as applied to the dental model is described in more detail below.

4.1.1 Model scoping

The purpose of model scoping was to clearly define the purpose of the model, the requirements, and equally as important, what was out of scope. It was determined during this stage that the model was required to:

- Calculate the supply and demand for the dental workforces from now to 2040.
- Segment the workforce by age and gender.
- Represent the training pipeline from entering university through to delivering service as fully qualified dentists.
- Represent the complex career paths for dentists following qualification.
- Integrate with large datasets from a variety of NHS and other official data sources.
- Use the data from the Delphi process that define the attributes for the expected future at 2025 and 2040 (i.e. the key future uncertainties).
- Enable policy analysis to be carried out to determine the impact of different policies on the different scenarios.
- Execute rapidly and produce outputs that can be readily analysed.
- Be fully tested and documented, with an audit trail for all assumptions.
- Allow the sensitivity of the input assumptions to be determined.

Part of the scoping process was the selection of the software tools to be used for model development. Vensim DSS was chosen as the appropriate tool to develop the system dynamics model. Vensim was able to handle the complexity of modelling supply, including the ageing of the workforce, and also offered sophisticated sensitivity and

uncertainty analysis functionality. This was an important feature given the variable quality of key data, and the assumptions that consequentially needed to be made by the CfWI.

Microsoft (MS) Excel 2007 was selected to act as an input data repository and a user interface to the system dynamics model to enable non-system dynamics analysts to more easily use the model and carry out policy analysis. The data repository side of the MS Excel spreadsheet would enable all data to be referenced and include a complete data audit trail.

4.1.2 Model construction

The initial stages of model construction were to map out the relevant processes of the training and career pathways with appropriate stakeholders from the dental system. The process maps were created in Vensim and printed out to be shared with the stakeholders. In addition, the process maps were presented at a series of national road shows hosted by the CfWI in 2012, which enabled over 80 people to comment and amend them. A high-level representation of the supply model stock-and-flow diagram is given in Figure 8.

Following review of the process maps with the stakeholders they were amended to reflect stakeholder comments and suggested changes. The process maps were then developed into a quantitative model that calculated the supply and demand dynamics over time. The model was developed iteratively. As each functional area was completed, the model results were shared with experts to determine whether the behaviour for that functional area was sensible and explainable.

Throughout the process many stakeholders helped to sense-check the accuracy of the model themselves or helped to provide or sense-check the data and modelling assumptions used. The large degree of stakeholder engagement throughout the process mapping stage ensured high levels of stakeholder buy-in to the modelling process.

4.1.3 Model Documentation and testing

The models were documented and tested by an analyst who was independent of the development process prior to use for formal policy analysis. A robust, formalised approach to testing was adopted. The purpose of model testing was twofold:

- to ensure that the model design has been transformed into a simulation model with sufficient accuracy
- to ensure that the simulation model is sufficiently accurate for the required purpose.

A test specification was developed to ensure that the testing was carried out methodically, and that all areas of the model were tested. The specification detailed all the tests to be carried out on the model, and included tests of the model structure, formulation and behaviour.

4.2 Model description

This section contains an overview description of the *Dentist Workforce Model*. The model architecture and the structures implemented for the supply and demand components of the model are described.

4.2.1 Model architecture

The diagram below illustrates the model architecture:

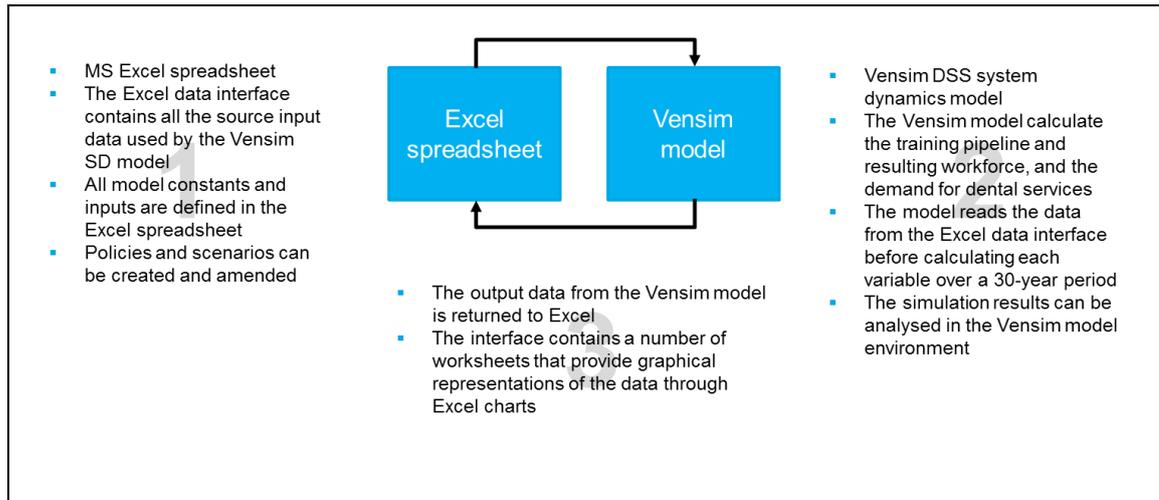


Figure 7– Dental model architecture

4.2.2 System dynamics model structure

The Vensim based system dynamics model contained two key model components. The first calculated the supply of dentists in terms of Head Count (HC) and Full Time Equivalents (FTE). The second calculated the future demand for dentists.

Both components needed to incorporate variables that represented the values for the uncertain supply and demand parameters at 2025 and 2040 generated using the Delphi process (See Section 3.2). These variables are termed the Delphi variables.

The supply and demand components are described below:

Supply model

The supply model component of the *Dentist Workforce Model* calculates the key dynamics of the dental training and career pathway system over a 30-year period. The stock and flow diagram (SFD) shown in Figure 8 is a high-level representation of the training and career pathways represented in the system dynamics model, and includes initial stock values.

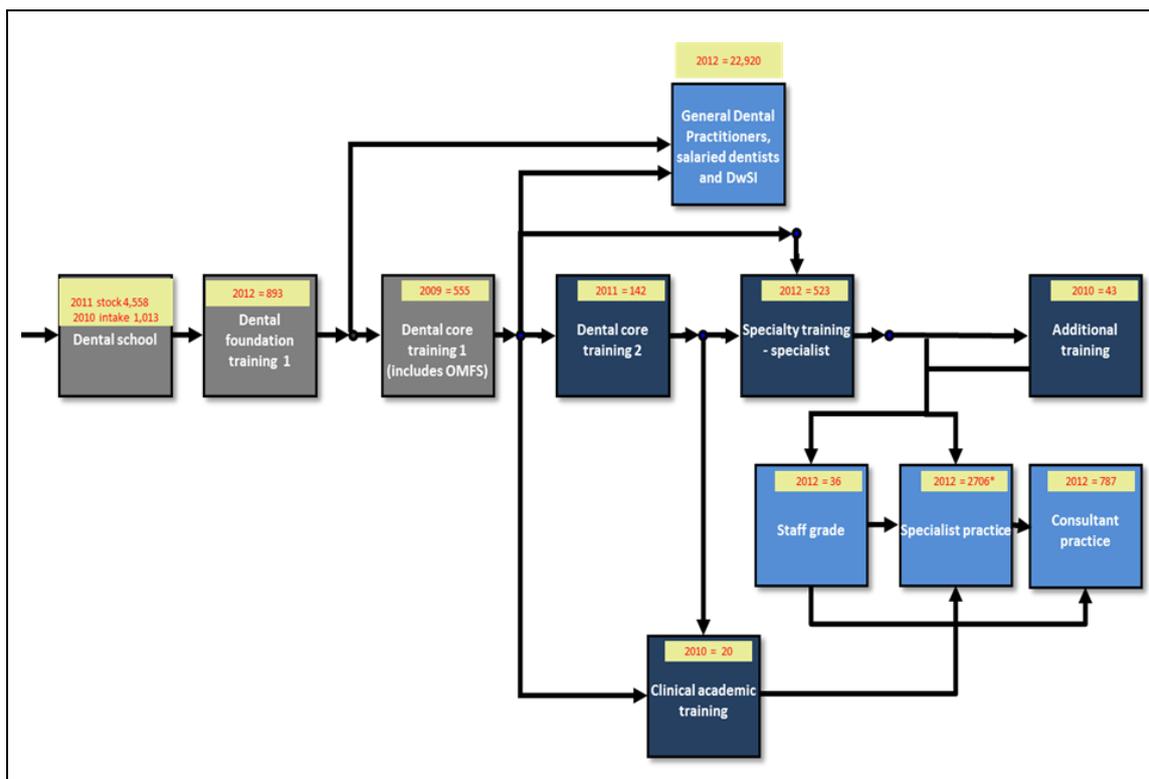


Figure 8 - High-level dentist training and career pathway stock and flow diagram (adapted from CfWI, 2013a)

The actual pathways represented in the *Dentist Workforce Model* are in fact much more complicated than that shown in Figure 9, and include all the additional flows that affect the stocks. These include attrition from the stocks, exits out of system, inflows from outside the system, workforce re-joiner, re-sits etc.

Furthermore, each stock and flow in the supply model is segmented by age (from 16 to 80 years) and by gender. This enables age and gender dependent impacts to be taken into account, for example attrition and participation rates³. The model has been developed so that additional segmentation can be added if required, for example if an explicit representation of visa status is required.

The model also contains training allocation algorithms and capacity constraints at each stage of the training pipeline. These enable the preference between types of training to be included. This allows the changes in future demography to be considered within the model, for example there may be gender preferences for different types of training and career path.

Finally, the supply model contained three Delphi variables:

- Average working hours per week in 2025 and 2040, by gender
- Average retirement age in 2025 and 2040, by gender

³ The extent to which the workforce work full or part time

- Change to the dentist workforce attrition rate (excluding retirement) by 2025 and 2040, by gender.

A more detailed view of the supply stock and flow diagram as implemented in Vensim is given in Figure 9:

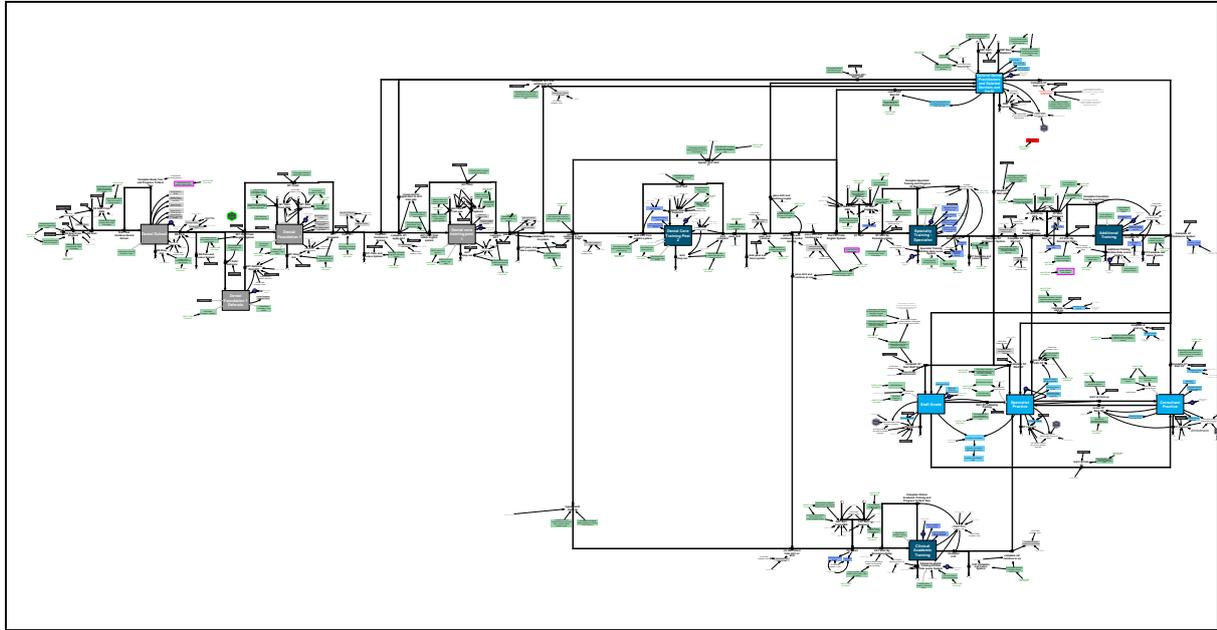


Figure 9 - System dynamics model Stock and Flow diagram of the dental training and career pathway system

Demand model

The demand model component of the *Dentist Workforce Model* calculates the future demand for dentists. The calculation is illustrated in Figure 10. The demand calculation is based on a framework from the Canadian research programme on health human resources (Birch et al, 2011). The framework is a decomposition method, which is an effective method for creating judgement based forecasts where uncertainty is high (MacGregor, 2001).

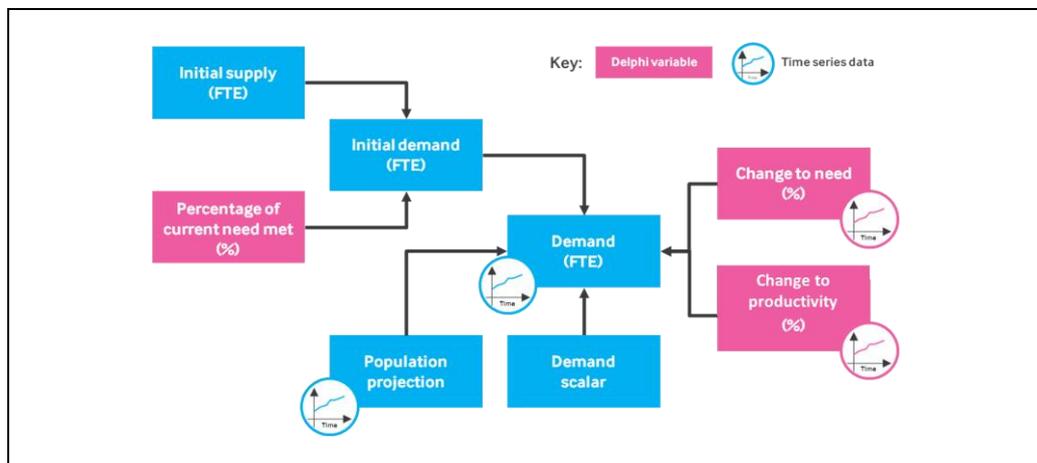


Figure 10 - Generic demand calculation structure

As shown in Figure 10, the future demand is calculated based on the current demand for dental services, the percentage of the current demand that is met, future population projections, changes in levels of need and changes in productivity (for example through technological advances) and changes in service delivery.

The current demand for service is based on the current FTE supply, and the percentage of the current need that is met. The percentage of the current need that is met is gathered from the Delphi process (See Section 3.2).

Population projections from the Office for National Statistics (ONS, 2012) by age and gender were applied with a suitable demand scalar to determine the current need by age and gender. A demand scalar is used to weight the contribution to demand made by different age groups. The demand scalar used was NHS dentist attendance rates per age bands from the 2009 Adult Dental Health Survey (Health and Social Care Information Centre, 2009).

Finally, parameters that determine potential changes in levels of need and changes in productivity are applied for 2025 and 2040. These parameters are Delphi variable and also determined through the Delphi process (See Section 3.2).

Calculating demand in the SD model enables comparisons between supply and demand to be quickly made, keeps supply and demand results sets together and facilitates future development where supply and demand could influence each other.

4.2.3 Policy levers

Policy levers are considered to be the parameters in the system over which it is possible to exert some degree of control. Policy decisions may result in changes to one or more policy levers. Ideally, the impact of these policy decisions will be to secure adequate supply to meet forecast demand.

Every single model input in the *Dentist Workforce Model* is defined in the MS Excel interface, and can be adjusted using time based profiles. This enables policy levers to be adjusted over time, and the impact of the adjustments simulated. Typical model inputs used as policy levers in the *Dentist Workforce Model* include:

- dental school intake
- intake to each stock from outside the system
- training delays
- limits on the number of available training places
- Changes to retirement profiles
- Changes to skill-mix

Sample policy analysis is given in Section 5.

4.2.4 Model initialisation data

A key requirement of the *Dentist Workforce Model* was to integrate system data from a variety of data sources. This data was used to initialise the model, for example to set the initial values for each workforce stock. The data used by the model was acquired from a number of sources, including:

- Health and Social Care Information Centre workforce data (2013b)
- Modelling the Dental Workforce Supply in England, School of Clinical Dentistry, University of Sheffield (2010)
- Health and Social Care Information Centre Adult Dental Health Survey (2009)
- Health and Social Care Information Centre Dental Working Hours Survey (2012)
- General Dental Council data

4.2.5 User Interface

As described in 4.2.1, in addition to storing all input data, the MS Excel spreadsheet also acted as a user-friendly model interface. The user interface enables the user to:

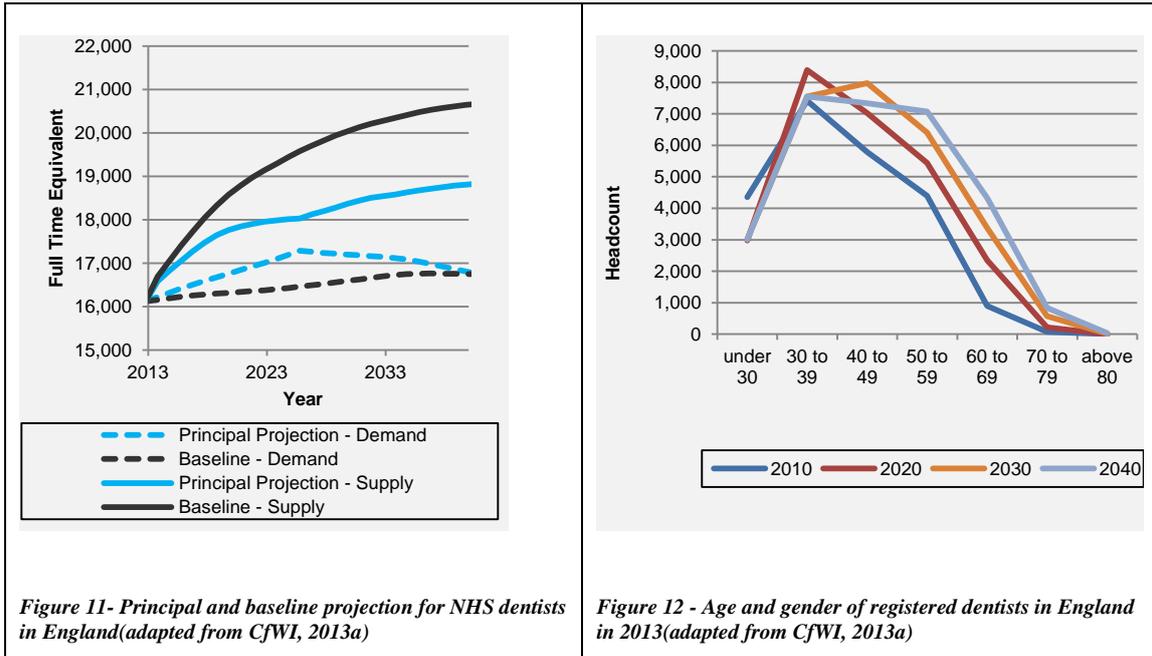
- create, store and edit future scenarios
- create, store and edit potential policies
- select scenarios and policies to simulate
- simulate the system dynamics model
- store the results of multiple simulations
- view and analyse the results of multiple scenarios.

4.2.6 Model size

The *Dentist Workforce Model* is composed of 17 separate influence diagrams which represent specific functional areas of the model. Across these diagrams there are 942 distinct variables, and the model is initialised with 13,000 items of data. The model takes approximately 10 seconds to simulate.

5 Use of the *Dental Workforce Model* in the strategic review

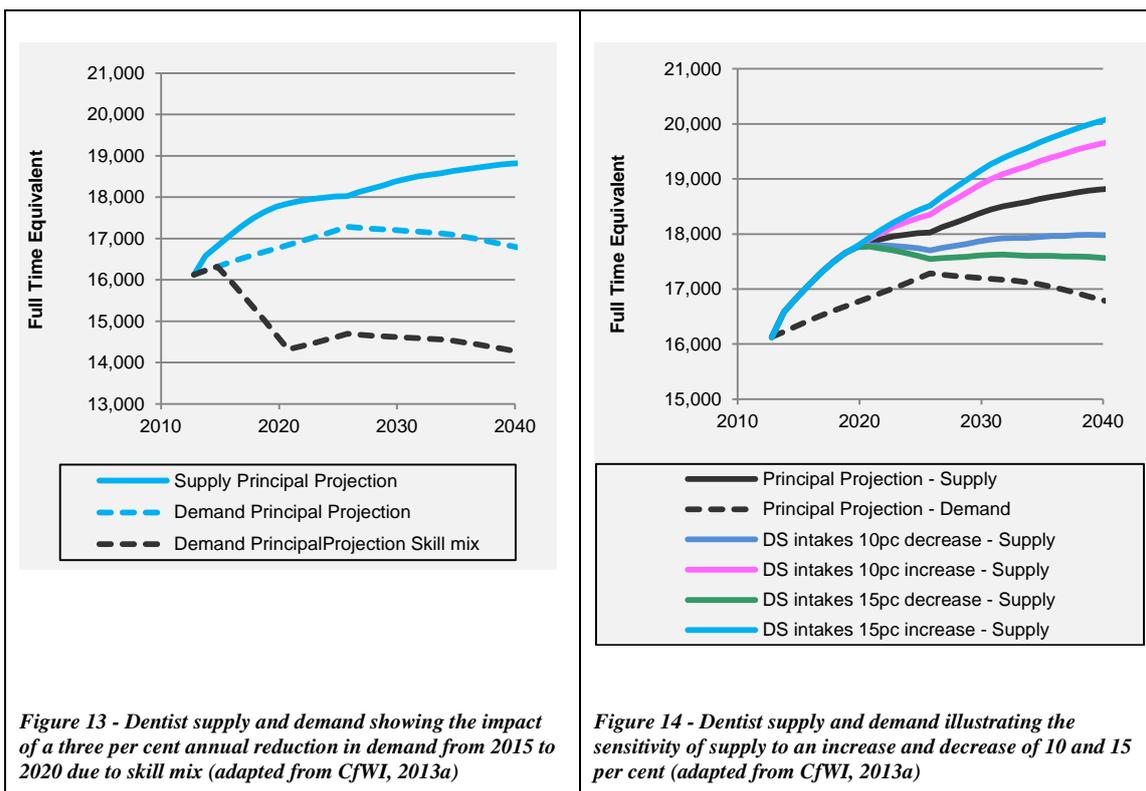
The *Dental Workforce Model* was used during the strategic review to determine projections for the supply and demand of dentists through to 2040. Figure 11 and Figure 12 give typical model outputs, showing supply and demand projections, and workforce age profile projections respectively.



The model was also used as a tool to test the impact of possible policies on the demand for, and supply of, dentists.

For example, Figure 13 gives an illustrative model output where the impact of changing skill mix is modelled. Skill mix refers to the ratios of different staff types used to deliver a service. For the purposes of modelling we represent the impact of changing skill mix by shifting dental workload (i.e. demand) to other workgroups. In this illustrative calculation we consider a three per cent annual reduction in demand for dentists from 2015 to 2020 due to skill mix.

Figure 14 illustrates another sample policy analysis where the impact of changing the number of entrants to dental school is modelled. The figure shows the long time delay between the policy introduction and changes to the size of the workforce. The graph also prompts the decision makers to consider what to do before the workforce reduction takes hold.



The model outputs were used by policy makers to understand the potential consequences of the various policy options. A more detailed review of the analysis carried out using the *Dental Workforce Model* is provided CfWI, 2013a

6 Conclusions

This paper describes a system dynamics model used in 2013 on a strategic review of the English dental workforce (CfWI, 2013a). The project was driven by the need to provide sustainable, high quality dental services in a complex and evolving environment given recent fluctuations in student numbers. The project was commissioned by Health Education England (HEE) through the Department of Health (DH) with the purpose of projecting and analysing the future supply of, and demand for, the English dental workforce through to 2040.

The project built on a review of the medical and dental student intakes carried out by the CfWI for the Health and Education National Strategic Exchange (HENSE) review group in 2012 (CfWI, 2012a). The system dynamics model developed for this review was significantly updated to support the 2013 review.

The use of a system dynamics approach meant that robust, evidence-based supply and demand models could be created to test future potential policies and their impact. It also meant that the model was “transparent” and made it possible to synthesise the expertise of several hundred stakeholders from within the dentistry system. The model also enabled rapid policy analysis to be carried out, allowing the impact of different policy levers to be explored.

The projections produced with the *Dental Workforce Model* indicated that there was a significant risk of a future oversupply of dentists for England. The principal projection showed supply and demand increasing in the medium term to 2025, with supply increasing at a greater rate than demand, and continuing to rise through to 2040, while demand starts to reduce after 2025. This decrease in demand was explained by the reduced need for dentists due to improved oral health which only partially counterbalances the additional need of older people retaining heavily restored teeth (CfWI, 2013a).

The model developed for this project has proven to be flexible and expandable, and will be used to monitor future changes in the dental workforce, and to inform subsequent reviews of dentists and dental care professionals.

In addition, the system dynamics approach is being used to develop supply and demand models for other workforces across the UK health and social care systems, including pharmacists, psychiatrists, social workers and General Practitioners.

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