2010

Improving Manpower Planning in Health Care

Martin Smits
School of Economics and Business, Tilburg University, m.t.smits@uvt.nl

Victor Slenter
Council for Medical Manpower Planning

Jac Geurts
School of Social Sciences, Tilburg University

23rd Bled eConference
eTrust:
Implications for the Individual, Enterprises and Society
June 20 - 23, 2010; Bled, Slovenia

Improving Manpower Planning in Health Care

Martin Smits[1], Victor Slenter[2], Jac Geurts[3]

[1] School of Economics and Business, Tilburg University, Netherlands

m.t.smits@uvt.nl

[2] Council for Medical Manpower Planning, Utrecht, Netherlands

[3] School of Social Sciences, Tilburg University, Netherlands

Abstract

In many countries manpower problems in the field of health care are regular items on the agenda of policy makers. To avoid mismatches between demand of care and supply of care on national and regional levels, manpower planning models and methods are used to determine adequate numbers of medical specialists to fulfil the future demand of care. A key question is which factors should be included in long term (25 years) forecasting and how these factors should be included in a planning model and method. In this paper we evaluate the model and the method for medical manpower planning that has been used since 2000 in the Netherlands. To improve accuracy and relevance of the model, we conclude that system dynamics modelling should be used and that strict distinction should be made between factors influencing the demand for care and factors influencing the supply of care.

Keywords: manpower planning, system dynamics, health care, forecasting, group decision making.

1 Introduction

How many medical specialists does a country need in the next 25 years? How can the costs of specialist health care be reduced? Which factors influence the regional cooperation between medical and community services? These are examples of messy problems in the field of health care. ‘Messy’ because different stakeholders are involved, each having different views on the problem area and trying to achieve different goals (Smits, 1995). Imbalance in the health workforce is a major concern in both developed and developing countries (Zurn et al, 2004). Imbalances are complex issues caused by various factors. At the one hand, structural elements like epidemiology and demographical developments of patient and doctor populations determine long-term changes in demand and supply of care. At the other hand more cyclical phenomena can be observed, like cyclical changes of the enrolment in specialist training programs for dentists and ophthalmologists (Postma et al, 1992; Capaciteitsorgaan, 2008) and nursing shortages (Zurn et al, 2004).

National policy attempts have been made in many countries over the past decades to prevent imbalances in the health workforce (WHO, 2010). Reasons to plan for human resources for health care are to prevent (i) under-employment of highly skilled professionals, (ii) over-employment of under-skilled employees for complex health care tasks, (iii) over-treatment of patients if too many medical or surgical specialists have been trained, (iv) poor geographical distributions of workforce between rural and urban regions, and (v) the political necessity of hiring more workers than can be reasonably afforded, resulting in low salaries, poor productivity, and high personnel turn-over (Hall, 1998). To prevent imbalances in the health care workforce in the Netherlands, the Royal Netherlands Society of Medicine initiated the Council for Medical Manpower Planning (Capaciteitsorgaan) in 1999, with funding by the Ministry of Health. The Council for Medical Manpower Planning (in short the Council) is responsible for long-term quantitative forecasting of supply and demand of care and the resulting need for enrolment in training programs for medical specialists. The Council has developed a method and a model to predict workforce needs in 10 to 20 year forecasts and to advise to the Ministry on the required numbers of medical specialists to be trained in order to achieve a balanced workforce.

In this paper we evaluate the method and the model that have been developed by the Council between 2000 and 2008. Our focus is on how the model and method support group decision making and policy making on health care manpower planning, and how the model and method can be improved. A key question is which factors should be included in long term (25 years) forecasting and how these factors should be included in a planning model and method. Our research question is 'how can the policy advice model and method of manpower forecasting be improved?'

We first summarize group decision making and manpower planning in health care (section 2), then introduce the method and the model of the Council as it was used in 2008 (section 3), and then evaluate the method and the model (section 4), ending with conclusions and recommendations.

2 Group Decision Making and Manpower Planning

In order to evaluate the method and the model for workforce planning we first summarize theory on group decision making and policy making (2.1) and then focus on theory for manpower planning (2.2).

2.1 Group Decision Making and Policy Making theory

For the messy problem above 'how many medical specialists does a country need in the next years ?', 'multi-aspect' means that the problem relates to several aspects, such as the medical care for patients, the educational capacities for the schooling of new medical specialists, the management of rheumatology care, the costs of medical care, the salaries of health care professionals. 'Multi-level' means that the problem can be viewed on, for instance, a national scale, a regional scale, and a local or individual scale. 'Multi-goal' means that the problem can be analyzed, aiming at various goals, such as reduction of the costs of health care, improving the quality of health care, and improving the management of care. 'Multi-paradigm' means that the problem can be viewed from different angles, such as the economical paradigm, the econometrical paradigm, the political paradigm, or the medical paradigm. Problem solving is not a very appropriate term in relation to messy problems: normally such problems are not solved by one best solution. It is better to speak of taking decisions for (a part of) the problem area. The problem is not resolved, but it is changed so that it can be handled by the stakeholders involved. Rosenhead (1989) uses the term 'resolution of a problem' versus 'dissolution of a problem'. The decision process for forecasting complex or non-programmed issues is based on bounded and political rationality instead (Simon, 1960; Cohen et al, 1972; Postma, 1989).

Policy making for messy problems (like manpower planning for health care) is also regarded as Group Model Building (GMB) (Vennix, 1996). GMB is a problem structuring method aiming to create (conceptual and quantitative) models of the policy problem for a group of stakeholders in the policy process. Eden and Ackermann (2006) list four properties of problem structuring methods (1) use of a model as a transitional object, (2) increasing the overall productivity of a group process, (3) attention to facilitate effective group process, and (4) appreciation of the significance of facilitation skills.

The theory of group decision making and policy making hypothesises that participation of stakeholders in the decision making (policy) process will lead to better, shared solutions (policy advices) for messy problems (DeSanctis and Gallupe, 1987). We apply this theory to the case study of manpower planning in health care.

2.2 Manpower Planning Theory

Generally speaking, manpower planning (MPP) is the development of strategies to match the supply of workers to the availability of jobs at organizational, regional, or national level. MPP involves reviewing current manpower resources (supply), forecasting future requirements (demand) and availability (supply), and taking steps to ensure that the supply of people and skills meets demand. At a national level, MPP may be conducted by government or industry bodies, and at an organizational level, by human resource managers (Makridakis and Hibon, 1979; WHO, 2010).

Geurts (2000) lists six criteria for a MPP model: (i) *usability*, or ‘the ability of the model to answer relevant questions’, (ii) *transparency* of the model structure and the model outcome, including sensitivity analysis, robustness, and transparency of the user interface, (iii) *flexibility* of the model to answer new questions and adaptable for future changes in the model structure and parameters, (iv) *reliability* of the data and statistical methods in the model, (v) *completeness* of the model from the user perspective, including coverage of the main political, societal, and financial developments, and (vi) *efficiency*, meaning that a generic model should be used for MPP for diverse (medical) professional groups instead of specialized models for all individual professions.

Zurn et al (a WHO publication in 2004) present a framework (Figure 1) of main factors that explain the long-term mismatches between demand of care and supply of care. They conclude that valid MPP models for health care should include these factors. Zurn et al distinguish between four contextual factors (socio-demographis, economic, cultural, and geographical factors), one resources factor (financial, physical, and knowledge resources), five policy factors (non-health and health policy), and five health care system factors that determine (shortage, equilibrium, or over-supply in) health labour demand and health labour supply.

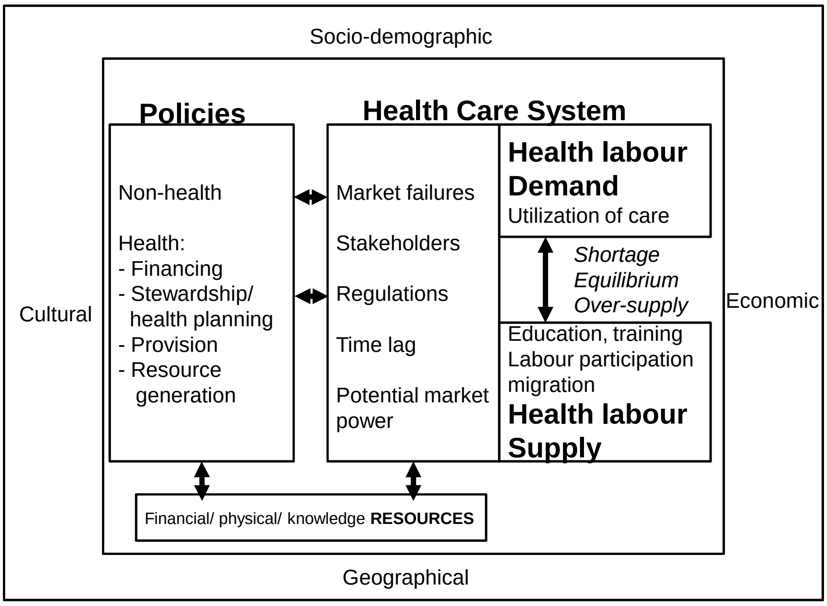

Figure 1. Framework of factors causing imbalances of human resources for health (Zurn et al, 2004)

The process of long-term manpower planning is closely linked to scenario planning. Basically speaking, scenarios are stories about possible futures. A scenario is not a story which portrays the future accurately but it is a story which makes people in an organization think, learn, adapt, and enrich the ongoing strategic conversation, which is both an art and a science (Van der Heijden, 1996). Geurts (2000) defines a stepwise process to define scenario's for MPP in health care. The process should start with defining the scenario topic and time horizon (between 3 and 25 years) and identifying key internal and external factors that determine demand and supply of health care. Two of these factors must then be selected, preferably two factors with highest impact on supply and demand and highest uncertainty. The two factors are used to design four scenarios, where each scenario is based on a combination of the future (high-low) state of each factor.

The theory of manpower planning hypothesises that good MPP models (i.e. models that comply with Figure 1) and a good MPP method or process (i.e. processes that comply scenario planning) will lead to better, shared solutions (policy advices) for MPP problems. We apply this theory to the case study of manpower planning in health care in the Netherlands.

2.3 Research method

Our research question focuses on how a model and a method for policy advice and policy decision making can be improved. A suitable research approach for such questions is the in depth analysis of a case study. In general, a case-based research strategy is applicable when control over events is not needed and when there is a focus on multiple level analyses (Yin, 2004). Our research consists of the analysis of one case and focus on the method and model for manpower planning as deployed in 2008.

We analyze the model and the method for manpower planning and policy making in the case of the Council. We validate the *model for policy advice* in two ways. First, we perform structural analysis by comparing the main structure and components of the model with the models by Geurts (2000) and Zurn et al (2004). Second, we perform a Plackett-Burman (1946) sensitivity analysis to determine the main input variables of the model (i.e. the input variables that have the largest effects on the output variables). The Plackett–Burman technique allows the concurrent consideration of many input parameters at a time instead of ‘naive’ sensitivity analysis based on assessing effects on changing one input variable at a time. Advantages of the Plackett-Burman technique include simultaneous investigation of all input variables, as well as acquiring information about two-way interactions between input variables, by means of a relatively small number of test scenarios (Campolongo and Saltelli, 2000). The required number of tests necessary for completion of a Placket-Burman analysis is approximately twice the number of input variables (instead of N! (where N = the total number input variables).

We evaluate the *method for policy advice* by interviewing ten members (a 12% random selection) of the Council that have used the model and participated in the policy advice process for several years.

3 The case of the Council for Medical Manpower Planning

The Council was initiated in 1999 by the Royal Netherlands Society of Medicine in the Netherlands, to predict long-term developments of available and required numbers for about 35 different types of medical specialist care in the Netherlands. The main task of the Council is to advise to the Ministry about the required enrolment of students in the (about 35) postgraduate medical specialist educational programs to balance future demand and supply of specialist care. Since 2000, the total number of medical specialists has grown from about 25,000 (on 14 million citizens) to about 30,000 (on 17 million citizens) in 2009. Some specialist groups have grown strongly (e.g. general practitioners), and others have grown mildly (e.g., general surgeons).

3.1 Model for manpower planning

The Council has developed a large Excel simulation model to perform planning calculations. Figure 2 shows the basic elements in the model for long-term forecasting for each of about 35 medical specialist groups in the Netherlands. Figure 2 represents the situation used for the advice in 2008 (‘year of advice’). For the advice of 2008, 47 different data are collected to quantify (i) the demand and supply of care for each specialist group in 2007 (the base year), (ii) the development of care demand, (iii) the development of care supply based on demographic changes in the specialist populations and the expected output of the specialist training programs, and (iv) the required (extra) enrolment in the training programs. Because specialist training programs have a duration of 2-6 years and drop-out percentages of 1-10%, there is a delay (indicated by the jump in the red curve in care supply after the training period) of 3-6 years and a loss of 1-10% of the manpower that becomes available for care supply.

Typically, after three years the Council repeats the planning calculations with a different base year (2010) and new data, thus enabling incremental decision making and incremental policy advices for required enrolment figures, if the new data indicate different long-term developments.

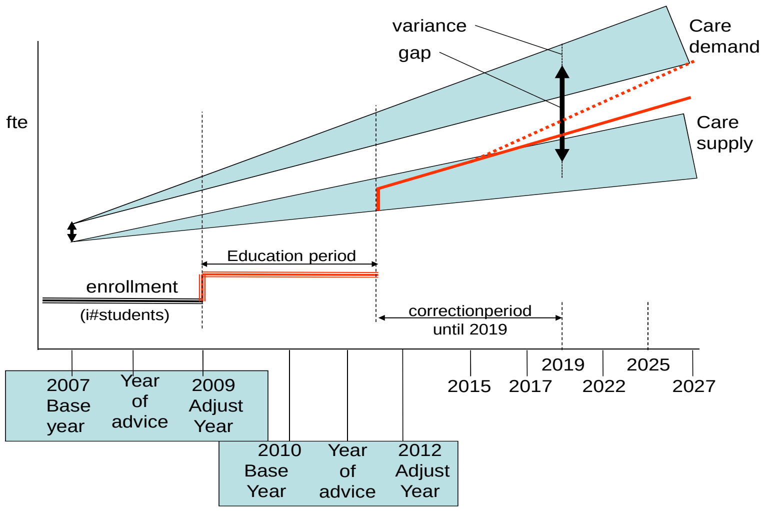

Figure 2. Main elements in the model for long-term planning of care demand, care supply, gap between demand and supply, and the change of student enrollment needed to repair the gap.

3.2 Method of manpower planning

The process (or method) of manpower planning and policy advice in the Council is represented in Figure 3. The process may start with adapting the Excel simulation model (step 1, upper left in Figure 3). In step 2, 40 new base data (input variables) are acquired for each medical specialism from various sources (Ministry, health research organizations like Nivel and Prismant) and 7 scenario data (input variables) are obtained from discussions in the Council discussion platforms (step 4). A discussion platform consists of representatives from three stakeholder groups: medical specialist representatives, health insurance company representatives, and board members of the university training programs. There are five specialized platforms focusing on specific specialist care groups.

The 47 data are entered in the simulation model to calculate demand, supply and required enrolment for the medical specialist group, resulting in a draft recommendation. The draft recommendation is discussed in the plenary platform of the Council, until agreement is reached on the enrolment advice to the Ministry. The Ministry receives the advice and national government decides on the total budget (up to 1.5 Billion Euro per year) to be assigned to training new medical specialists. The budget is divided among the teaching hospitals (in the CBOG/ BOLS/ VWS platform) and will ultimately affect the Care supply in the future. Care supply is also influenced by other factors (social, cultural, economic and political).

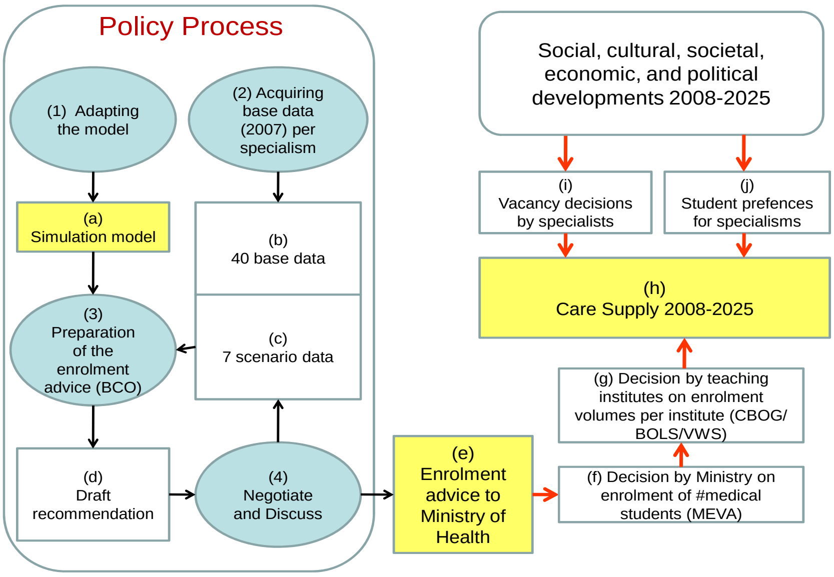

Figure 3. Overview of the policy process (left side) in the Council, the enrolment advice to the Ministry and the (indirect) effects of the on long-term care supply.

The complexity of the process is related to the different interests of the decision makers. Health insurance companies are interested in high amounts of medical students and future doctors as competition can increase quality of care and decrease prices, but consider also the unwanted effects of supplier induced demand. Educators strive to stable student groups because teaching capacity is difficult to adjust. The medical specialist groups prefer a lower amount than the insurers, but enough young specialists to take over specialist practices (and pay for retirement plans). Nevertheless, the objective of this group decision making process is to achieve a shared vision of the current situation and to a shared advice to the Ministry. The shared objective for the Council stakeholders is to fulfil the demand of care, quantitatively as well as qualitatively.

4 Case Analysis

4.1 Analysis of the model for Manpower Planning

Structural analysis of the simulation model shows that the components of the model fit the components given in the framework by Zurn (Figure 1). The model calculates the required enrolment for the medical specialist training programs in a linear (Excel based) way, but without any dynamic feed-back mechanisms that exists in long-term manpower developments that exist in the models by Zurn and Geurts.

We find 22 input variables that are entered in the model to calculate the base scenario for the development of demand and supply (in full time equivalents (FTE)) per specialist care type. These 22 variables consist of

- 8 variables to calculate the supply of care in the base year (2007). These variables include the numbers of male and female specialists and the FTEs (‘part-time factors) per male and female specialist.

- 5 variables to calculate numbers of specialists in the training programs (2007-2015). These variables include the numbers of male and female students and the efficiency of the training program.
- 4 variables to calculate numbers of specialists in the training program (after 2015)
- 3 variables to calculate numbers of specialists coming from abroad (EU)
- 2 variables to calculate the demand for specialist care. Note that the demand of care is calculated as the supply of care in 2007 plus the unfulfilled demand for care (= 'the number of specialist vacancies in 2007'), plus demographical development of the national population.

Seven additional input variables are entered in the model to calculate the impact of additional effects on demand and supply of care. These additional variables are epidemiological developments (varying from +0.3 to +1.3% increase of demand for care per year (example percentages for general practitioner specialist care)), social cultural developments (+0.5 to 1.5%), medical knowledge developments (+0.1 to 1.1%), efficiency improvements in the care process (-0.2% to -1.2%), horizontal substitution of care (+0.5% to +1.5% due to replacement of medical specialists by, e.g., nurse practitioners), substitution of care by other specialists (-0.6% to 0.4%), increase of part-time factor for medical specialists (-0% to -1.0%).

Sensitivity analysis (Plackett-Burman) shows that only seven out of 22 variables significantly affect the outcome of the simulation model for the base scenario. The analysis shows that the uncertainty in these seven variables accounts for 17% uncertainty of the output variables. So, if the model calculates the required yearly enrolment as 552 students, then the statistical spread is 457 to 647 students (± 95 students). This spread is relatively high given the detailed discussions on required enrolment in the discussion platforms of the Council and in subsequent phases of the policy process (see Figure 3).

Sensitivity analysis also shows that the impact of the seven additional (scenario) variables is substantially stronger than the 22 base variables. The impact of each of these seven variables is three times (± 300 students for private practitioner enrolment) the impact of the base variables.

Structural analysis of the model shows that the seven additional input variables all influence only the demand for care and not the supply of care. The model uses variables like 'socio-cultural developments' and 'epidemiological developments' to calculate changes in the supply of care, instead of using these variables to calculate changes in the demand for care. This means that the model may be correct with respect to the calculation of required enrolment of specialist students (to close the gap between supply and demand) but that the model cannot be used to calculate estimates of future demand and supply of care.

We conclude that the model can be improved by including feedback mechanisms (and using system dynamics software (or other software) that supports feedback calculation mechanisms) and that the model can be improved by linking two out of the seven additional (scenario) variables to development of demand of care (epidemiological developments and social cultural developments). The other five variables (medical knowledge developments, efficiency improvements in the care process, horizontal substitution of care, substitution of care by other specialists, increase of part-time factor for medical specialists) should be linked to the development of the supply of care.

4.2 Findings on the process for MPP

To evaluate the process for MPP, we interviewed ten members of the advisory platforms of the Council (this is a 12% representative sample of all 87 members). The interviews took about 45 minutes each and were based on six open questions:

- Can you describe the advisory process, its triggers and objectives?
- Do you consider the advices to be a fair balance between stakeholder objectives?
- Has the health care environment been more dynamic than expected in 2000?
- How transparent do you consider the decision process, the policy advices, and the scenarios?
- Has the Council moved to a more political advisory position since 2000?
- What is your opinion on working with models in the Council processes?

The interview results show that the model and the method have been useful, but the scenarios are hard to understand for the relatively inexperienced members of the advisory platforms. The model and method are not transparent and only comprehensible for a small group of model specialists. The model and process are not flexible, but regarded to be reliable if handled properly. The model is regarded to be incomplete because several policy variables have not been included. The model is regarded to be efficient because only one model and method is used for MPP for all specialist types.

5 Conclusion

The research question in this research was 'how can the policy advice model and method of medical manpower forecasting be improved'. Based on the in depth analysis of method and model for manpower planning (MPP) in the Council case and comparison of the case findings with criteria for MPP models and method from literature, we conclude that models based on linear calculations (like Excel) cannot sufficiently support long-term MPP. Dynamic models are required to enable valid MPP. Dynamic models based on system dynamics software may also increase transparency of the MPP model and process, if management dashboards and cockpits (which are functionalities available in such software) are implemented.

We found that the MPP model used by the Council does not support separate estimates of long-term supply of care and demand for care. Also, the uncertainty of input variables for the model account for an uncertainty margin of ± 17% in the base scenario and ± 60% for each of seven scenario variables. To improve relevance of the model, we conclude (i) that strict distinction should be made between factors influencing demand for care and factors influencing supply of care, and (ii) that clear distinctions must be made between base MPP predictions of demand and supply of care and impact of scenario variables on demand versus supply of care.

Limitations of this research are of course that conclusions are based on a single case in one country. Extrapolation of our findings to other MPP and policy making in health care is difficult because different circumstances and objectives in other countries will affect MPP models and policy making. However, careful analysis and comparison of the findings in one particular case to general criteria for MPP and policy making, as we attempted to do in this research, may be used to develop guidelines for MPP and policy making in other settings.

References

Campolongo, F. and Saltelli, A. (2000): Design of Experiments. In: Saltelli,A., K.Chan, and E.M.Scott. Sensitivity Analysis, Wiley, Chichester.

Capaciteitsorgaan (2008): (in Dutch) Capaciteitsplan 2008: Advies 2008 over de initiele opleiding geneeskunde. Report, Utrecht (www.capaciteitsorgaan.nl)

Cohen, M. D., March J. G., and Olsen, J. P. (1972). A Garbage Can Model of Organizational Choice. Administrative Science Quarterly, 17, 1-25

DeSanctis, G. and Gallupe, B.,R.(1987). A foundation for the study group decision support system. Management Science, 33

Eden C, Ackermann F (2006): Where Next for Problem Structuring Methods. Journal of the Operational Research Society 57(7): 766-768.

Geurts JLA (2000): Options for usable long-term planning models for demand and supply of medical specialists. Report Council, IVA-Tilburg, Netherlands (in Dutch)

Hall TL (1998): Why plan human resources for health. Human Resources for Health Development Journal. 2 (2) 77-86.

Makridakis S, Hibon M (1979): The accuracy of forecasts: An empirical investigation. Journal of the Royal Statistical Society, Series A 142 (1979), pp. 97–145

Plackett RL, Burman JP (1946): The design of optimum multifactorial experiments. Biometrika 33, 303-325.

Postma TJBM (1989): Strategical decision processes in hospitals. Thesis. Groningen University (NL).

Postma TJBM, MT Smits, S Terpstra, CAT Takkenberg (1992): Personnel planning in health care: an example in the field of rheumatology. In Proceedings of the System Dynamics Conference (Ed. JAM Geurts), Nijmegen.

Rosenhead, J., (1989), Rational Analysis for a problematic world. Wiley, Chichester.

Simon, H. (1960). The new science of management decision

Smits MT (1995): Group decision making for messy problems: stakeholders, mental models, and system dynamics. In: Proceedings of ECIS (eds Doukidis et al). Pp 683-694.

Van der Heijden K (1996): Scenarios: the art and science of strategic conversation, John Wiley & Sons Ltd, London.

Vennix JAM (1996). Group decision making. Wiley: London.

WHO (2010): World Health Organization, web site accessed January 2010. www.who.int/topics/human_resources_health/en/index.htm.

Yin RK (2003): Case study research design and methods. Sage Publications, Inc, Thousand Oaks, (Ca), USA.

Zurn P, Dal Poz MR, Stilwell B. Adams O (2004): Imbalance in the health workforce. In: Human Resources for Health, 2: 13, p 1-12.