Chapter 12
Identifying Critical Issues for Developing Successful e-Health Solutions

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Abstract As an industry, healthcare exhibits numerous contradictions, most notably with regard to its embracement of technology. On one hand, medical science is at the cutting edge with technology playing a key role in new techniques in oncology and cardiology as well as advances in various aspects of biomedical engineering. In contrast, healthcare delivery is a noted laggard with regard to its incorporation of technology. Current challenges which are impacting all members of the Organization for Economic Cooperation and Development (OECD) countries (including longer life expectancy, ageing population and technological changes) continue to exponentially affect rising health expenditures. Reducing these expenditures as well as offering effective and efficient quality healthcare treatment has now become a key priority on all healthcare agendas. Technology and automation in general have the potential to reduce these costs; hence, OECD countries are now looking at how to use information and communication technologies (ICT) in general and e-health solutions in particular to address these challenges and thereby enable superior healthcare delivery.

The following presents the key points and initial findings from an exploratory research in progress that is focused on uncovering critical issues for developing

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successful e-health solutions in two OECD countries: Australia and Germany. Additionally, in this research we focus on the principles of lean thinking and six sigma as well as lean six sigma. We also discuss how these approaches can be used to reduce the weaknesses and threats of Australia's and Germany's e-health solutions by using the TOWS analysis tool.

Keywords e-Health • e-Health card (eHC) • Electronic health record (EHR) • Electronic health professional card (HPC) • Electronic prescription (e-prescription) • Personally controlled electronic health record (PCEHR) • Australian healthcare system • German healthcare system • Lean thinking • Six sigma • Lean six sigma

12.1 Background

Healthcare industries continue to be at the forefront of agendas globally. Between 1970 and 1997 the average percentage of gross domestic product (GDP) on healthcare by members of the Organization for Economic Cooperation and Development (OECD) countries rose from about 5 % to roughly 8 % (Huber 1999). Since 2000, total spending on healthcare in these countries has been rising faster than economic growth, which has resulted in an average ratio of health spending to GDP of 9.0 % in 2008. Challenges including technological changes, longer life expectancy and population ageing serve to push health spending up further. Hence, such a growing health spending creates a significant cost pressure for several countries (OECD 2010a).

Reducing these expenditures as well as offering effective and efficient quality healthcare treatment is a priority worldwide. Technology and automation in general have the potential to reduce these costs (Abd Ghani et al. 2010). Moreover, the use of information and communication technologies (ICT) in e-health solutions in particular appears to be the key to respond to these challenges (Wickramasinghe and Schaffer 2010).

Given that the current situation is no longer feasible, we are witnessing a focus by all OECD countries on developing new healthcare reforms where a key role is played by ICT most especially e-health solutions. Hence, this chapter presents the key points and initial findings from our research in progress exploratory study which serves to uncover critical issues for developing successful e-health solutions. Specifically, we use a multiple case study analysis to examine the e-health solution developments in the OECD countries Australia and Germany. Additionally, we focus on the principles of lean thinking and six sigma as well as lean six sigma and discuss how these approaches can be used to reduce the weaknesses and threats of Australia's and Germany's e-health solutions. This is done with the use of the TOWS analysis tool.

12.1.1 Literature Review

In order to realise the aims and objectives of this research, it is necessary first to summarise the germane issues of NCHO (network-centric healthcare operations) as it provides the logical framework for all successful e-health solutions (von Lubitz and Wickramasinghe 2006). In addition, it is necessary to discuss the different types of healthcare systems and to define e-health.

12.1.1.1 Network-Centric Healthcare

The doctrine of NCHO has been defined as "unhindered networking operations within and among the physical, information, and cognitive domains that govern all activities conducted in healthcare space based on free, multidirectional flow and exchange of information without regard to the involved platforms or platform systems, and utilising all available means of ICCTs to facilitate such operations" (von Lubitz and Wickramasinghe 2006, p. 334; Jamshidi 2009).[1]

The confluence of three domains is critical to the success of NCHO (Wickramasinghe and Schaffer 2010; von Lubitz and Wickramasinghe 2006): (1) information domain contains all elements, which are required for generation, storage, dissemination/sharing, manipulation of information and in addition its transformation and dissemination/sharing as knowledge in all its forms; (2) physical domain encompasses the structure of the entire environment healthcare operations intended to influence indirectly or directly (political environment, fiscal operations, patient and personnel education, etc.); and (3) cognitive domain relates to all human factors, which affect operations—education, training, experience, motivation and intuition of individuals involved in the relevant activities.

Based on this information, it is important to look at a healthcare information grid. This grid allows a full and hindrance-free sharing of information among the individual domains and their constituents as well as among constituents across the domains. Moreover, the grid forms the basis for the overarching IT architecture and infrastructure needed to support any e-health solution. The grid must typically consist of an interconnected matrix of ICT systems and capabilities (communication platforms, data collection, etc.) and associated processes like knowledge and information storage, people (healthcare providers, etc.) and agencies (governmental and non-governmental organisations) at a local, national or international level, so as to achieve such a function (Wickramasinghe et al. 2007).

As noted in the literature (Wickramasinghe et al. 2007; Porter and Teisberg 2006; von Lubitz and Wickramasinghe 2006), it is essential to position the healthcare organisation and the e-health initiative in view of external pressures and present

[1] The abbreviation ICCT stands for information, computer and communication technologies.

trends. In order to achieve this, it is vital to take a network-centric perspective and to design an e-health solution to support NCHO (von Lubitz and Wickramasinghe 2006). The critical success factor here is not the technology per se rather the macro understanding of the need to design suitable technology-enabled solutions (Wickramasinghe and Schaffer 2010).

12.1.1.2 Different Healthcare Systems

Healthcare systems can be thought of as traversing a continuum (Wickramasinghe et al. 2007; Porter and Teisberg 2006; von Lubitz and Wickramasinghe 2006). On one side of the continuum, we have a healthcare system that is primarily predicated on private healthcare (e.g. the US healthcare system) while on the other side, a healthcare system that is mainly based on a public healthcare system (e.g. the United Kingdom healthcare system), and then finally in the middle a variety of 2-tier healthcare systems.

For the purposes of this study, a 2-tier healthcare system is defined as a system, where, in addition to a guaranteed public health insurance, a private healthcare system exists, which can have a substitutive or complementary function, and different factors like income and job status, which may or may not influence the classification of an enrollee (ArticlesBase.com 2009).

Specifically, this chapter focuses on the Australian healthcare system and the German healthcare system as exemplars of 2-tier healthcare systems in OECD countries. At this time, both are in the process of not only developing new healthcare reforms but also designing and developing e-health solutions to improve their respective healthcare delivery systems. Table 12.1 summarises the relevant key facts of the Australian and German healthcare systems.

12.1.1.3 e-Health

For the purposes of this chapter, the term "e-health" will be used as defined by WHO: "a new term used to describe the combined use of electronic communication and information technology in the health sector" or as "the use, in the health sector, of digital data-transmitted, stored and retrieved electronically for clinical, educational and administrative purposes, both at the local site and at a distance" (WHO 2005).

As discussed in the literature, e-health is the main driver for three significant changes within the healthcare environment (Maheu et al. 2001): (1) patients to become better informed, (2) patients to become more active and empowered in their healthcare, and (3) healthcare to become more efficient.

Based on this, Table 12.2 serves to summarise key e-health developments to date in Australia and Germany.

Table 12.1 Summary of key facts of the German and Australian healthcare systems

Theme	Australia	Germany
Healthcare expenditure	2007: total expenditure on health 8.5 % of GDP: US$3,353 per capita (OECD 2010b)	2009: total expenditure on health 11.6 % of GDP (2.1 % higher than the average ratio of the OECD countries); US$4,218 per capita (OECD countries spent on average US$3,223 per capita) (OECD 2011)
Healthcare system structure	The healthcare system consists of public and private components. The public health insurance under Medicare is funded by taxation. Enrollees have the possibility to use subsidised medical services and pharmaceuticals as well as free of charge hospital treatment according to their status as a public health enrollee. Besides Medicare, Australian patients have the possibility to use, in addition, a private health insurance, which gives, e.g. patients access to dental services and hospital treatment as a private patient (The Commonwealth Fund 2010)	(1) Healthcare actors: enrollees, service providers (medical doctors, pharmacists, hospitals) and cost units (health insurance companies). Around 70.23 million people of around 82.14 million inhabitants have public health insurance. Around 8.62 million people use a private health insurance. 319,697 medical doctors, 2,087 hospitals and 21,602 pharmacies (BMG 2009). 195 health insurance companies (146 public (GKV-Spitzenverband 2012) and 49 private (Verband der privaten Krankenversicherung e. V. 2011) health insurance companies). (2) Health insurance is compulsory for all citizens. Depending on factors like income, job status, etc. enrollees have either public and/or private health insurance (The Commonwealth Fund 2010)
Financing of the healthcare system	Healthcare system is financed by (The Commonwealth Fund 2010): (1) National health insurance: Medicare (compulsory and administered by the government); Medicare is funded in large part by general revenues and partly by a 1.5 % levy based on taxable income; depending on the income of an individual or family the amount of levy can change; in 2007 till 2008, the governments funded 69 % of all health expenditures, while 43 % came from the Federal and 26 % from State or Territory governments. (2) Private insurance: 7.6 % of total health spending can be contributed to the private health insurance; since 1999, the Australian government has supported private health insurance by giving enrollees a rebate of 30 % of private health insurance premiums; the government's rebate increases for elderly; in mid of 2009, 44.6 % of Australia's population had a private hospital insurance; private health insurance is in Australia community-rated ("everyone pays the same premium for their health insurance") (Australian Government 2012); nonprofit as well as for-profit insurers. (3) Out-of-pocket spending: in 2007 till 2008, 16.8 % of health expenditures were out-of-pocket spending; e.g. dental services and copayments on medical fees	(1) Public health insurance companies are autonomous, non-profit-oriented and nongovernmental bodies, which are regulated by law. This system is financed by premiums charged as a percentage of the gross wages up to a threshold. Based on the facts of July 2009, the employee contributes 7.9 % of their gross wage, while the employer adds 7.0 % on top of the gross wage, which is in total a premium of 14.9 % of each individual's gross wage. Dependents like kids and spouses without income are also included (The Commonwealth Fund 2010). (2) Private health insurance is taking mainly a substitutive function. This private health insurance scheme is covering two groups, who are mostly exempt from public health insurance (The Commonwealth Fund 2010): civil servants and people with high incomes

Table 12.2 Key e-health issues in Australia and Germany

Theme	Australia	Germany
Background	(1) Problem with Australia's healthcare system: the usage of ICT is very low (Pearce and Haikerwal 2010). A comparison of health information technologies between developed countries: Australia's system was ranked in the middle—its use of modern electronic solutions for communication and information exchange within the health systems was low (Jha et al. 2008). (2) National E-Health Transition Authority Limited (NEHTA): founded by the Australian Commonwealth, State and Territory governments in July 2005; plays an important role in order to achieve a higher level of electronically collecting and securely exchanging healthcare information (NEHTA 2012a)	The gematik (Gesellschaft für Telematikanwendungen der Gesundheitskarte mbH), which is an organisation founded on January 11, 2005, has been charged with the aim to implement the German e-health card (eHC) and the necessary telematics infrastructure (gematik 2012a)
e-Health strategy	NEHTA's strategy (NEHTA 2012b): deliver, operationalise and enhance the essential foundations required; coordinate the progression of priority e-health initiatives; manage the delivery of key components of DOHA's (Department of Health and Ageing) PCEHR Programme; accelerate national adoption of e-health; lead the further progression of e-health in Australia	eHC: will change healthcare delivery in Germany; concept allows several new functions; will lead to a more connected healthcare system

e-Health functions	(1) Personally controlled electronic health record (PCEHR): an individual electronic health record (EHR) of a patient; summarises key medical information of a patient from different systems centrally; only the patient or authorised healthcare providers will have access to the PCEHR; information of a PCEHR will support healthcare providers in their decisions and treatments; it will be also possible for a patient to add own information to his/her PCEHR (NEHTA 2012c). Benefits of this solution are, e.g. higher level of quality of care; time savings through a faster availability of health information; better communication between healthcare actors (NEHTA 2012d). (2) To realise the PCEHR, the Australian government allocated around $466 million over 2 years in the 2010 budget (Pearce and Haikerwal 2010)—overall Australians will support the idea of an individual electronic health record, but they have concerns about data security and privacy. Eighty percent want that participation is voluntary and most of the Australians want that Federal government will manage this implementation (NEHTA 2008). (3) NEHTA is also working on e-communications in practice (NEHTA 2012e): e-Diagnostic Imaging; e-Pathology; e-Discharge Summaries; e-Referrals; e-Medication Management. (4) Electronic prescription: developing a national electronic prescription system (NEHTA 2012f). (5) For using e-health services, it is essential to have a Healthcare Identifiers (HI) Service. The HI Service includes identifiers, which are unique 16-digit reference numbers (The Royal Australian College of General Practitioners 2010): Individual Healthcare Identifier (IHI); Healthcare Provider Identifier—Individual (HPI-I); Healthcare Provider Identifier—Organisation (HPI-O). (6) Identifiers allow to identify a healthcare individual at the point of care uniquely and consistently and to connect healthcare data of an individual within a healthcare context (NEHTA 2010)	(1) Functions of the eHC are divided into two category groups: administrative functions, which are compulsory for all card owners; medical functions, which are optional for the card holders (Barmer GEK Krankenkasse 2012). (2) Storage of information about the insurance agreement and the necessity of additional payments (compulsory): data will be stored on the eHC respectively on a server and can be updated, e.g. during every consultation of a doctor through an online process. Storage of data about the care provider and personal information about the enrollee. Each enrollee will become a lifelong valid insurance number, which will be printed on the eHC. Each eHC will be equipped with a personal photo of the enrollee. Through this lifelong valid insurance number and the personal photo the eHC is well protected against misusage (gematik 2012b). (3) Insurance coverage for enrollees within the European Union (compulsory): requirement is that the appropriate countries have a social agreement among each other. The back side of the eHC is perfect as identity card for the European Health Insurance Card (EHIC) (European Commission 2012). (4) Electronic prescriptions (e-prescription): compulsory for all involved healthcare actors in Germany; possible to remove the approximately 600–700 million paper-based prescriptions and to process these transactions electronically; necessary signature of the doctor will be generated electronically with the aid of the electronic health professional card (HPC) (Die gesetzlichen Krankenkassen 2007). (5) Storage of personal health data about the enrollees (optional): examples are documentation of medicine and storage of an emergency data record of the enrollee in case of emergency; due to the medicine documentation it is possible to avoid interdependencies between the individual drugs (gematik 2012c); the emergency data should help the emergency doctor to medicate purposefully and effectively, because patient's allergies and chronic illnesses can take into consideration through the therapy (ZTG 2010). (6) Electronic health record (EHR): With this optional EHR it is possible to have access to the entire patient's data. For example, the EHR can include information about medications, past medical history and radiology reports. The patient's data can be accepted, processed and attended centrally (GVG 2004)

12.2 Initial Results and Preliminary Findings

In order to uncover critical issues for developing successful e-health solutions, we embarked upon an exploratory, multiple case study research subscribing to the directives of Kvale (1996), Boyatzis (1998) and Yin (1994). Our analysis is being conducted at two levels macro and micro in both Australia and Germany (see Fig. 12.1).

Moreover, we are targeting exemplar case studies as per recommendations of Yin (1994)—where it is noted that exemplar case studies are a particularly good source for uncovering new, novel issues and insights especially, when nothing or little is known about a phenomenon at the time. Thus for Australia we choose a public and a private hospital and in Germany we focus on a typical German hospital. This is appropriate because the basic rollout of the German eHC is targeting only enrollees of public health insurance companies to date, and because these enrollees typically cannot utilise services of a private hospital which will be paid through their public health insurance companies, this study takes only a public hospital in Germany into consideration.

In addition, in order to get an in depth understanding of key issues, we are currently performing extensive qualitative data analysis predominantly in the form of over 50 unstructured interviews of key factors including medical practitioners, nurses and IT specialists in the respective hospitals. Further, triangulation is being achieved by in depth examination of critical documents and the application of a survey instrument to a wider target group including enrollees and/or users of the system. Questions are primarily focused on the respective national e-health solution, the transferability of e-health solutions as well as the idea of a global e-health solution.

While conducting thematic analysis, key themes and subthemes were developed. The themes were chosen based on literature including key aspects of NCHO and a socio-technical perspective while emergent themes were derived from the data such as "lack of awareness" which became a very key emergent theme especially in the Australian context.

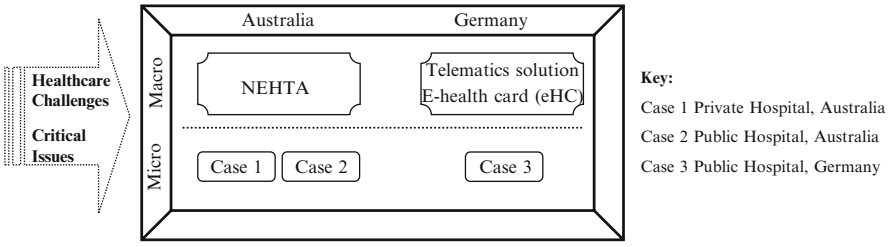

Fig. 12.1 Schematic of study design

From Table 12.3 it is important to highlight that both solutions try to establish national e-health solutions to cut costs and provide high-quality care. However, the German e-health solution to date appears to integrate all the web of healthcare players, while the Australian e-health solution is struggling to bring together a fragmented healthcare delivery system. This important finding also indicates that while both as planned subscribed to the principles of NCHO, it would appear at this stage that the German e-health solution is on track to be realising a NCHO while the Australian solution is struggling in this regard.

From an initial analysis of the unstructured interviews conducted to date, we find that most of the concerns are related to the theme of people issues, including confusion between the different stakeholders regarding the end solution and how it is in fact beneficial and useful, to at times not even being aware of its existence and how they will need to interact—e.g. with the PCEHR in Australia, the solution developed by NEHTA—key stakeholders including medical providers and pharmacists as well as citizens are confused about their role regarding interacting with this system; while in Germany, strong concerns by medical professionals have served to halt the initial design and development of the e-prescribing module.

In addition, we find process issues appear to date to be more problematic in the Australian context but this is partly due to the fact that the Australian healthcare delivery system is and has been historically complex and fragmented. Thus, this finding indicates that redesigning of this system before the implementation of the PCEHR might be prudent. Finally, in both countries technical concerns while prevalent appear to be at this point the least problematic.

12.3 Lean Thinking, Six Sigma and Lean Six Sigma

This section will give an overview about lean thinking, six sigma and lean six sigma as well as how these approaches can improve e-health solutions.

Lean thinking is an approach of managing an organisation with the goal to improve effectiveness and efficiency and also the quality of products and services. The approach was originally developed in the automotive industry at Toyota. There are several principles of lean thinking which organisations have to follow in order to achieve a lean enterprise (International Technology Centre and National Research Council Canada 2004):

- Definition of value precisely from the end customers' perspective, in terms of a specific product or service, with specific capabilities, offered at an explicit price and time
- Identification of the entire value stream for each product or service and eliminate unnecessary process steps
- Making of the remaining value-creating steps flowing
- Designing and providing products or services depending on customers' needs and requests
- Pursuing of perfection

Table 12.3 SWOT analysis of e-health to date in Australia and Germany

Theme	e-Health in Australia	e-Health in Germany
Strengths	First step for the fragmented structure to become a more coordinated system → in the context of its possibilities this approach should lead to a better information exchange, cost and time savings and higher quality of care	The German eHC connects all healthcare stakeholders nationally → better information exchange, cost and time savings and higher quality of care (mhplus Krankenkasse 2011; vdek 2012)
Weaknesses	(1) Costs; (2) Time schedule uncertain to attain; (3) Still underlying fragmented system → healthcare information exchange is difficult respectively not possible between different stakeholders	(1) High implementation costs of approximately 1.7 billion Euros and 150 million Euros running costs a year (Scheer 2009); (2) Time schedule: the implementation of the eHC does not meet the deadline for several times → several decision-makers
Opportunities	(1) Possibility for health information exchange with other countries; (2) First step for a healthcare information exchange between different stakeholders worldwide and is consistent with NCHO; (3) Australia's e-health solution is a first step to develop a national e-health solution → doctrine of NCHO	(1) Possibility for health information exchange with other countries; (2) First step for a healthcare information exchange between different stakeholders worldwide and is consistent with NCHO; (3) Contribution to life savings; (4) Potential to reduce health expenditures; (5) Extending scope of healthcare delivery
Threats	(1) Several decision-makers; (2) New laws from the government means maybe changes in the e-health solution; (3) Data security and data protection; (4) Information overload of a patient → doctor can lose overview and lose time; (5) Doctors need more time for documentation; (6) Acceptance by Australians is questionable; (7) Australia's e-health solution has still a complex structure because of different systems → therefore higher risk for succeed superior healthcare delivery; (8) Australians are concerned of costs	(1) A big range of decision-makers; (2) New law changes from the government; (3) Data security and data protection; (4) Information overload of a patient → doctor can lose overview and lose time; (5) Doctors need more time for documentation; (6) Acceptance by Germans is questionable

Lean thinking means the following benefits (Joint Commission on Accreditation of Healthcare Organizations 2008):

- By involving all stakeholders in the problem-solving process valuing diversity
- Information sharing between employees, which leads to a cross-functional understanding, process awareness and less rework
- Identification of process steps where waste occurs in order to promote implementation of solutions immediately
- Giving employees an increased feeling of empowerment and control
- Encouraging of team spirit

The six sigma approach is defined as "a systematic and statistically based process to reveal defects in performance, driven by customer specifications. Six Sigma methodologies aim to reduce the variation in clinical and business processes which give rise to long cycle times, high cost and poor outcomes" (Lazarus and Novicoff 2004). To achieve true "six sigma" levels, it is necessary to produce acceptable quality over 99.99 % of the time (Lazarus and Novicoff 2004).

It is important to notice that lean thinking and six sigma complement each other.

Benefits of six sigma and lean six sigma are (Go Lean Six Sigma 2012):

- Increases revenue
- Decreases costs
- Improves efficiency
- Develops effective people/employees

The five basic phases of six sigma and lean six sigma are (Go Lean Six Sigma 2012):

- Define: problem definition and definition of customer requirements
- Measure: description of the process in order to proceed data collection
- Analyse: investigation and identification of problem reasons
- Improve: implementation of a fix for problem solving
- Control: sustainment of the improvements

Lean thinking and six sigma are not only approaches which can be used in the manufacturing industries; they also are able to lead to contributions in the healthcare sector. Lean six sigma can help, e.g. to increase the time, which care providers can spend with their patients, reduce paperwork and reduce waiting times (Go Lean Six Sigma 2012).

George (2003) focuses especially on lean six sigma in the service industry. He mentions an example, where Stanford Hospital and Clinics' application of the approach of lean thinking and six sigma leads to a situation, where they could deliver higher quality of care with lower costs. In addition, they could regain market share from their local competitors (George 2003).

Lean Six Sigma for services has the potential to maximise shareholder value by improvement of customer satisfaction, cost reduction, quality improvement, process speed increase and maximised return on invested capital. The combination of lean thinking and six sigma is required because (George 2003):

- Lean thinking does not use statistics to control processes.
- Lean thinking is necessary for dramatic changes and therefore improvement of processes. Six sigma alone cannot reduce process speed extraordinarily and cannot reduce the invested capital.
- Both approaches together enable the reduction of the costs of complexity.

12.4 Discussion

In this section, we will use the TOWS analysis tool and discuss how lean thinking, six sigma and lean six sigma in the e-health context can help to minimise the weaknesses and threats from the SWOT analysis in Sect. 12.2.

The following Table 12.4 shows the TOWS matrix instrument. It is important to note that the TOWS analysis is used here on a national scale and not originally intended and normally used on a company level. Therefore, the TOWS analysis has needed an adaption.

The explanations of the four strategies are (Koontz and Weihrich 2008; Weihrich 1982; 1999):

- SO Strategy: take advantage of opportunities by using the strengths
- WO Strategy: defeat weaknesses to take advantage of opportunities
- ST Strategy: avoid or deal with the treats by using the own strengths
- WT Strategy: minimisation of weaknesses as well as threats

Based on these facts and our purpose to reduce the weaknesses and threats of Australia's and Germany's e-health solutions through lean thinking, six sigma and lean six sigma, we will concentrate our discussion on the WT Strategy (Mini–Mini).

Weaknesses and threats minimisation:

- *Costs* (Australia and Germany): Lean Six Sigma for services has the potential to reduce costs (George 2003). This is very important, because the costs of an e-health solution implementation but also running costs can also have a negative impact on the *acceptance* (Australia and Germany) of the e-health solution. It is important to note that the e-health solution can also reduce costs by its nature, but if processes are not adapted and not well connected or cannot interact with each other, costs will rise. For example, if an e-prescription solution will be used to reduce paper costs, e.g. between a doctor and a pharmacist, but for invoicing a printed prescription in a later process step is requested, benefits

Table 12.4 TOWS matrix (adapted from Koontz and Weihrich (2008), Weihrich (1982), Weihrich (1999))

	Strengths	Weaknesses
Opportunities	SO strategy: maxi–maxi	WO strategy: mini–maxi
Threats	ST strategy: maxi–mini	WT strategy: mini–mini

like paper saving will be abolished. This is exactly what we also know from the principles of lean thinking, where unnecessary process steps should be eliminated to reduce costs.

- *Time schedule* (Australia and Germany): Australia and Germany have problems with the e-health implementation to attain their time schedule, because there are among other things different opinions/requirements between the different e-health stakeholders, which were not addressed adequately, because they were not involved enough in the development. When we consider the principles of lean thinking, it is important to design the e-health solution on customers' needs and requests (International Technology Centre and National Research Council Canada 2004); therefore, it is important to look on the care providers' needs, patients' need, etc. If this principle is accounted, the *acceptance* (Australia and Germany) will rise, because all the *several decision-makers* (Australia and Germany) will be included and therefore all the e-health stakeholders will benefit from the e-health solution. But this means also that Australia has to bow out of the idea of an *underlying fragmented system* meaning *a complex structure*, because only a national e-health solution can connect the different e-health stakeholders and allow that the health information is fast available where and when needed, which will result in *succeed superior healthcare delivery*. Of course, if the *several decision-makers* (Australia and Germany) are included in the development and implementation of an e-health solution, this can be seen as a risk, e.g. resulting in a longer *time schedule* (Australia and Germany), but therefore it is important to look on the lean thinking principle and define value precisely from the end customers' perspective (care providers, patients, etc.) in terms of a specific service, with specific capabilities, offered at an explicit price and time (International Technology Centre and National Research Council Canada 2004). If this is accounted, the situation is clear for every stakeholder from the very beginning. In the first moment it takes more time, but the overall decision process is faster, because stakeholders were included early and have therefore not the feeling of segregation and have a more open mind for the interests of others. This fact will also help in Australia, because *Australians are concerned of costs* and therefore it is important to involve them and show them the costs they will be confronted with but also the benefits. The encouragement of team spirit is here overall a very important point, which is a benefit of lean thinking (Joint Commission on Accreditation of Healthcare Organizations 2008).
- *New laws from the government* (Australia and Germany): This threat can be minimised through involvement of all stakeholders as lean thinking is provided (Joint Commission on Accreditation of Healthcare Organizations 2008). By considering this, the government could avoid to introduce laws or law changes that will be completely against the other stakeholders.
- *Data security and data protection* (Australia and Germany): This threat cannot be overcome with a guarantee, because there is always a risk of hacker attacks, etc. But this threat can be minimised through the basic phases of six sigma and lean six sigma, which means that potential problems are defined and measured

and problem reasons are analysed, improved and controlled (Go Lean Six Sigma 2012). The continuous improvement process is here important.

- *Information overload of a patient, which means that doctor can lose overview and lose time* (Australia and Germany): As we know, lean six sigma can help to reduce paperwork and reduce waiting times (Go Lean Six Sigma 2012). In addition, the lean thinking principle of designing and providing services depending on customers' needs and requests (International Technology Centre and National Research Council Canada 2004) can help here, so that the right information is at the right time at the right place.
- *Doctors need more time for documentation* (Australia and Germany): Lean six sigma can help to increase the time, which care providers can spend with their patients and reduce paperwork (Go Lean Six Sigma 2012). This time can be spent on the detailed documentation of health information of a patient and can therefore minimise this threat. This can at the same time help to increase the *acceptance* (in Australia and Germany) within the care providers, because they have not additional overtime and also patients will be more open to an e-health solution, if this solution does not mean that the doctor has less time for treatment decisions then. Lean Six Sigma for services has the potential to maximise shareholder value by improvement of customer satisfaction (George 2003).

As we have seen, lean thinking, sig sigma as well as lean six sigma have the potential to minimise weaknesses and threats resulting of an e-health solution respectively an e-health solution development and implementation. What we have also seen in our discussion is that weaknesses and threats can depend on each other. It is important to note that these principles do not help if the stakeholders are not showing the required willingness.

12.5 Conclusion

All OECD countries are currently being confronted with rising healthcare expenditures and focusing on healthcare reform enabled through ICT use as a panacea. e-Health appears to be the solution of choice for all these countries as they respond to the key healthcare challenges. This makes it vital to understand the critical issues for developing successful e-health solutions; an area the literature has been mute on to date. Thus, our study has tried to shed light on this by embarking on a deeper examination of the Australian and German e-health developments, two OECD countries that have respectively 2-tier healthcare systems and are currently embarking upon e-health initiatives and healthcare reforms to address the key healthcare challenges. Our preliminary findings have already uncovered many interesting points of note. Specifically, the SWOT analysis has demonstrated that the construction of e-health solutions is a challenging endeavour, and thus appropriate facilitators must be identified in order to realise a

successful vision and thereby by achieve better healthcare outcomes. Moreover, it serves to identify that realising a network-centric healthcare solution is not at all an easy task. In addition, it serves to raise the question about the transferability of e-health solutions especially within similar healthcare systems, e.g. Australia and Germany. Other preliminary findings from our case study data at the micro level of analysis serve to indicate that while indeed a socio-technical perspective is important and people, process and technology considerations must be addressed in developing successful e-health solutions, it appears that the people issues especially given the existence of multiple-stakeholders in healthcare contexts appear to be a major barrier to success. Without a doubt e-health in some shape or form represents the future for healthcare delivery. Based on our analysis to date, it is possible to make the following recommendations: (1) For Australia: NEHTA should try to bring the different stakeholders together, increase the general awareness and understanding related to the PCEHR as well as make the healthcare delivery system itself less fragmented; (2) For Germany: the government together with the key stakeholders and organisations need to work together to ensure high acceptance by the citizens; (3) There are potential lessons to be learnt from other industries such as banking that can and should be applied into both settings; (4) International bodies such as the United Nations and/or World Health Organization should take the lead in developing global protocols and policies regarding e-health solutions; in this way, increasing the likelihood of appropriate network-centric healthcare solutions resulting; and (5) Given the importance of e-health today, as well as its growing importance in the future, it may be prudent for the development of a new international organisation that solely focuses on key e-health considerations including security and privacy aspects as well as standards and protocols.

In addition, we have used the TOWS analysis matrix and have shown how the lean thinking, six sigma and lean six sigma approaches can help to minimise the weaknesses and threats of Australia's and Germany's e-health solutions. This can help them for the success of their e-health solutions, which is very important based on the fact that e-health can lead to superior healthcare delivery.

The limitations of our study are mainly concerned with the possibility of information loss through translation (English vs. German) and the fact that the key stakeholders in the respective countries do not have exactly similar roles, responsibilities and tasks with regard to the design and implementation of the proposed e-health solution.

We close by calling for more research into this context and note that we are confident that at the conclusion of our study we will be able to shed light on: (1) How to find better strategies so that countries can fight against their weaknesses and threats which in turn will result in superior healthcare delivery; (2) How countries can focus on a national and even a worldwide e-health solution, which is the idea of NCHO; and (3) Key considerations regarding the issue of the transferability of e-health solutions between countries.

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