Assessing the costs and benefits of Water Safety Plans

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Abstract: A survey was conducted to assess the costs and benefits of the WSPs developed at 197 production units operated by the SUEZ Company and serving a total of 10.6 million consumers in France, Spain, Cuba, Morocco and Macao. The results demonstrate benefits in terms of confidence of clients and health agencies. The main benefits however consist of a better control of hazards, especially new hazards that were previously overlooked, and of the treatments steps which are deemed as the most important for water safety. As the progress achieved is essentially linked with unregulated contaminants, improvements in compliance rate were rarely observed after implementation of WSPs. It is supposed that better control of these hazards, together with improved process control, result in improved safety for the consumers.

Keywords: Drinking water, Water Safety Plan.

Introduction

Since the publication of the third edition of the Guidelines for Drinking Water Quality by the World Health Organization (WHO, 2004), many Water Safety Plans (WSP) have been developed throughout the world. Only a few studies however have been dedicated so far to the assessment of costs and benefits of WSPs. According to these studies, the estimated benefits include a reduction in customer complaints, improvements in water quality, in process performance, in work processes and system infrastructure, cost savings, increased communication and collaboration among stakeholders, increased training leading to improved knowledge and attitudes among staff and stakeholders (Martel, *et al.*, 2006, Dyck, *et al.*, 2007, Gelting, *et al.*, 2012). More recently, the impact on consumers' health was also investigated in Iceland (Gunnarsdottir, *et al.*, 2012). In addition to a significant decrease in HPC and in non-compliance following WSP implementation, the results of this study also showed a significant decrease in the incidence of diarrhoea, with populations where WSPs were implemented being 14% less likely to develop clinical cases of diarrhoea. In this context, the objective of our study was to assess the costs and benefits of the WSPs developed in a large set of drinking water production and distribution units operated by the SUEZ Company worldwide.

Material and Methods

A survey based on a questionnaire and interviews was organized to collect the information from the persons who played a major role in the implementation and the management of each WSP. The survey covered a total of 197 production units located in France, Spain, Cuba, Morocco and Macao, serving a total of 10.6 million consumers. The systems investigated are presented in Table 1. Except in one case, all these systems have been certified according to the ISO 22000 standard (ISO, 2005).

The questions principally addressed the following points: time and cost of implementation, estimated benefits of the WSP, difficulties found in the implementation, and necessary conditions for a successful implementation. There was only one response per site. Results were expressed as the sum of responses to each proposed item. Respondents were requested to differentiate between simple and major benefits, difficulties, or conditions for implementation, and each individual response quoted as "major" was considered as double.

Table 1 Drinking water systems investigated

Country	Contract	Number of production units	Population served	System	Year of implementation	Scope	
						Production	Distribution
France	Biarritz	3	400 000	ISO 22000	2008	X	
	Bordeaux	67	685 000	ISO 22000	2014	X	X
	Cannes	5	330 000	ISO 22000	2009	X	X
	Grasse	0	51 000	ISO 22000	2014		X
	Lille	10	1 200 000	ISO 22000	2010	X	X
	Orléans	3	118 000	WSP	2012	X	X
	Paris Southern Suburb	7	1 000 000	ISO 22000	2007	X	
	Rambouillet	3	26 000	ISO 22000	2015	X	
	Pierrefitte en Auge	1	86 000	ISO 22000	2007	X	
Spain	Barcelona	2	3 000 000	ISO 22000	2009	X	X
	Murcia	28	470 000	ISO 22000	2011	X	X
	Tarragona	8	145 000	ISO 22000	2010	X	X
	Salou – Vila-seca	8	46 000	ISO 22000	2013	X	X
	Santiago de Compostela	7	96 100	ISO 22000	2011	X	X
	Pontevedra	5	82 000	ISO 22000	2011	X	X
	Ourense	11	107 500	ISO 22000	2014	X	X
	Valladolid	7	300 000	ISO 22000	2013	X	X
	Albacete	4	172 500	ISO 22000	2014	X	X
Cuba	Varadero	14	11 300	ISO 22000	2012	X	X
Morocco	Casablanca (SEOER)	1	1 700 000	ISO 22000	2010	X	
China	Macao	3	600 000	ISO 22000	2012	X	X

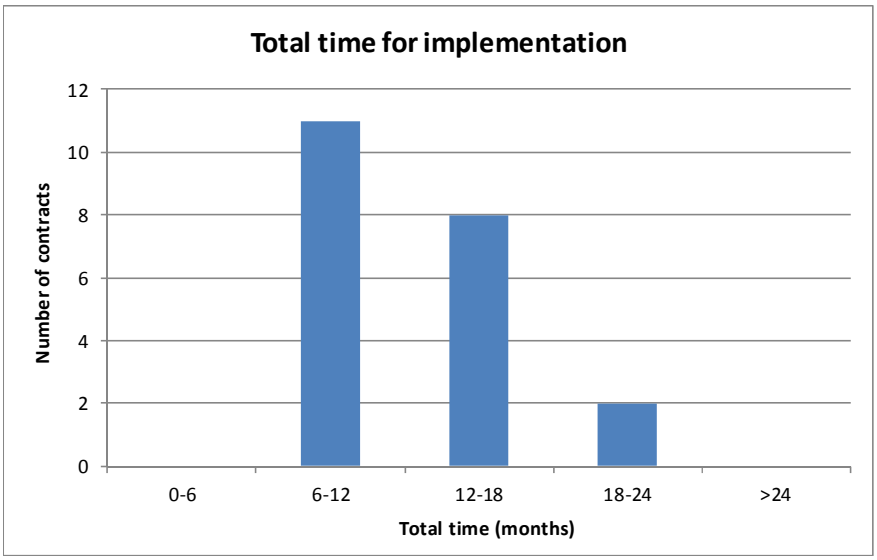
Results

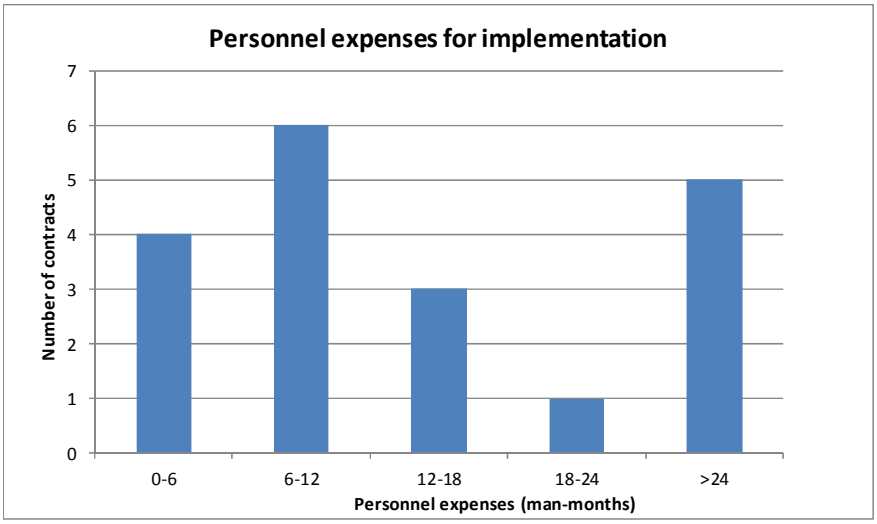
Time and costs

Responses on total time for implementation and personnel costs, expressed as Full Time Equivalent (FTE) for system implementation and maintenance, are shown on Figure 1. Additional costs mentioned in the responses principally included training, education, consultancy, audits, and in some cases a need for investments was also mentioned, but in the great majority of cases, all these additional costs were lower than the personnel costs.

Responses showed important variations, with:

- An average total time for implementation of 13 months (minimum 7, maximum 24),
- An average FTE for implementation of 16 man-months (minimum 3, maximum 48),
- An average FTE for maintenance of 7 man-months/year (minimum 2, maximum 34).





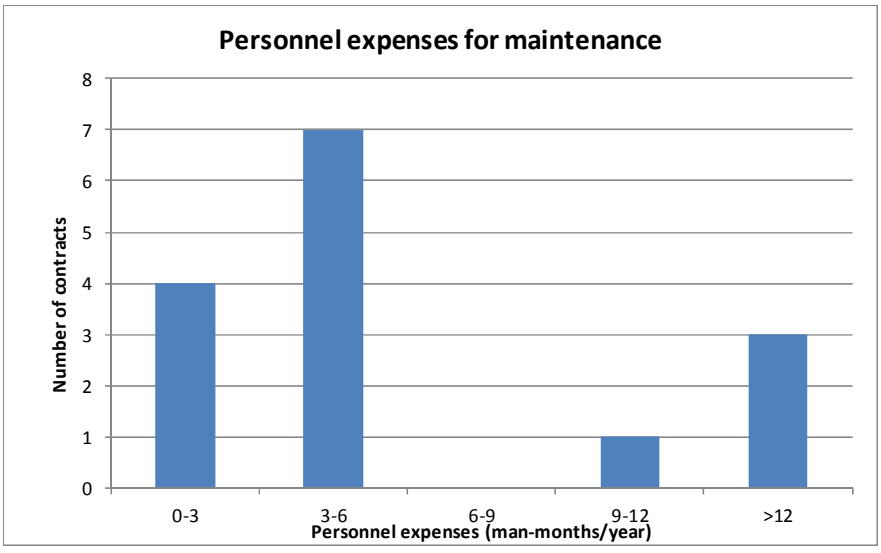


Figure 1 Distribution of time and personnel costs for implementation and maintenance

These variations can be only partially explained by the size and complexity of the system (some large systems requiring more time for implementation, but not necessarily more personnel costs), and by the year of implementation (recent systems needing slightly less time and less personnel costs for implementation, probably because of the experience gained over the years). It is interesting to note that several systems implemented a certified WSP in less than one year, and that a system serving 1.2 million consumers required only 9 equivalent man-months for implementation. A more probable explanation to these differences is the development of measures going in some cases far beyond the strict requirements of the ISO 22000 standard. After excluding these few extreme cases (corresponding to the last bar on the right on the histograms of Figure 1), the average time and costs for the majority of the systems considered become:

- 12 months for the total time of implantation,

- 10.5 man-months FTE for implementation,

- 4 man-months/year FTE for maintenance.

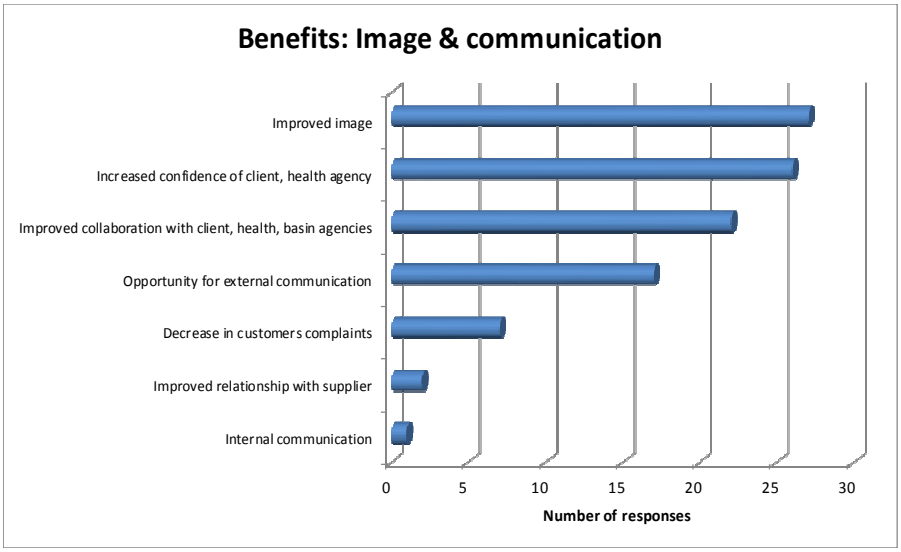
The great majority of these systems were certified according to the ISO 22000 standard. It is more likely that the costs for a non-certified WSP should be in the lower range of observed costs, close to those of the only non-certified WSP included in this study that requested an implementation time of only 7 months, and 4 man-months FTE.

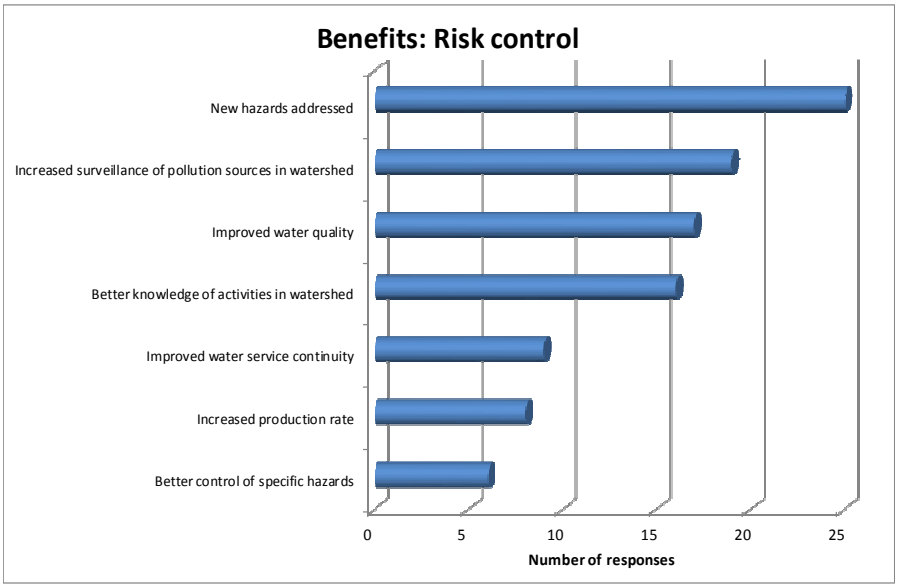
Estimated benefits

The benefits, as perceived by the respondents, were grouped into three categories: image and communication, risk control, and operational benefits. The answers, ranked by order of importance, are presented on Figure 2.

- Image and communication: Although benefits in terms of image are difficult to assess, a majority of respondents declared a feeling of improved image and increased confidence that was perceptible from their contacts with their clients and with the health agencies, following the certification. In some cases, this was reinforced by the fact that the client and/or the health agency had been associated to the development of the WSP, and integrated into the WSP management team. For 6 contracts, a decrease in the number of customers' complaints could be observed.

- Risk control: The major benefit in this category appeared to be the control of non-regulated contaminants that had never been taken into account before the WSP. Since these contaminants are not regulated, no improvement was visible through the statistics on compliance, but the respondents supposed that this would contribute to the provision of "improved water quality", as indicated by the high level of responses for this item. Another major benefit in this category was the better knowledge and surveillance of pollution sources in the watershed. In a few cases, the WSP allowed to justify the installation of monitoring stations on water resources.





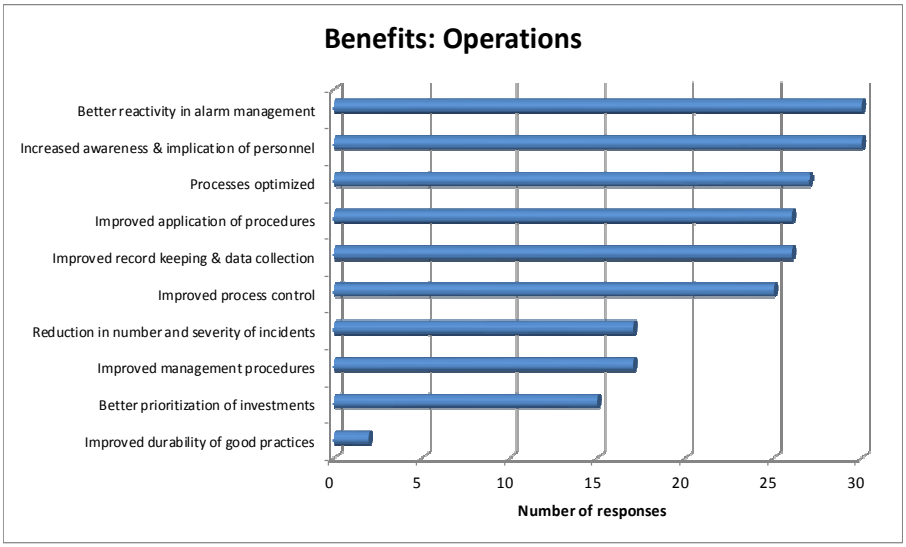


Figure 2 Estimated benefits of WSPs (coefficient 2 for major benefits)

- Operational benefits: Despite the fact that all the sites considered in this study were ISO 9001 certified before the implementation of the WSP, the benefits in this category were ranked higher than the others, and multiple benefits were identified. The two major benefits in this category were a better reactivity to alarms, especially those related with the critical control points, (i.e. treatment steps whose control is absolutely necessary to ensure water safety), since they were better identified as requiring a higher level of priority, and an increased awareness and implication of the personnel in water safety, due to a better knowledge of the consequences of their work on consumers' health. This second point is a consequence of the education and training programs generally deployed with the WSPs. This point is of particular importance for the personnel affected to the distribution since the consciousness of health impacts in this sector is generally not so much developed as in the production plants. Process optimization, better process control (e.g. improved control of chlorination levels and of THMs in distribution systems), and reduction in number and severity of incidents were also ranked high.

Challenges to implementation

The challenges and difficulties found during the implementation of the WSPs are presented by order of importance on Figure 3. Obtaining from the suppliers certificates of approval of chemicals and materials for contact with drinking water constituted the major difficulty, whatever the geographical location. Another difficulty often reported was related with the level of detail of the hazard assessment. As expected, difficulties related with limited staff time were also reported.

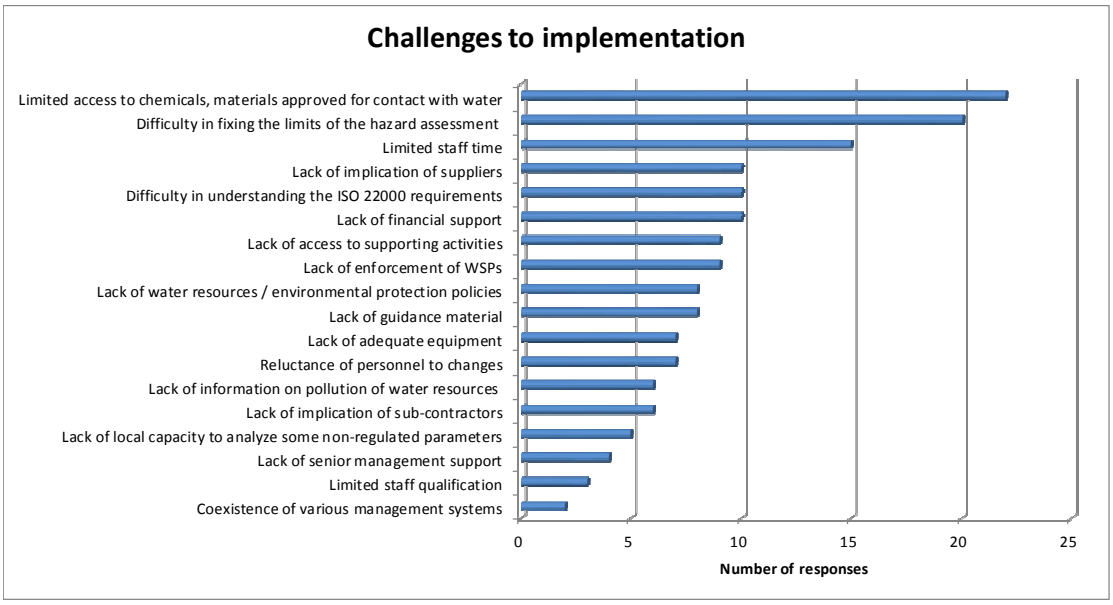


Figure 3 Challenges to the implementation of WSPs (coefficient 2 for major challenges)

Conditions for success

The conditions for a successful implementation of an efficient WSP, as estimated by the respondents, are presented by order of importance on Figure 4. These responses especially highlighted the need to involve all categories of staff in the WSP development (the system must be based on staff experience), as well as the importance of the support from the senior management. The responses also highlighted the need for a dedicated project manager (not necessarily full time). Site-specific and exhaustive hazard assessment, training sessions explaining the implications of operational practices for consumers' health, and insertion of the system in the existing day-to-day management processes (avoiding additional paperwork), were also important conditions for success.

Guidelines for implementation, database of hazards and control measures, education and training programs, and sharing internal auditors were identified as the major needs in view of further deployments at new sites.

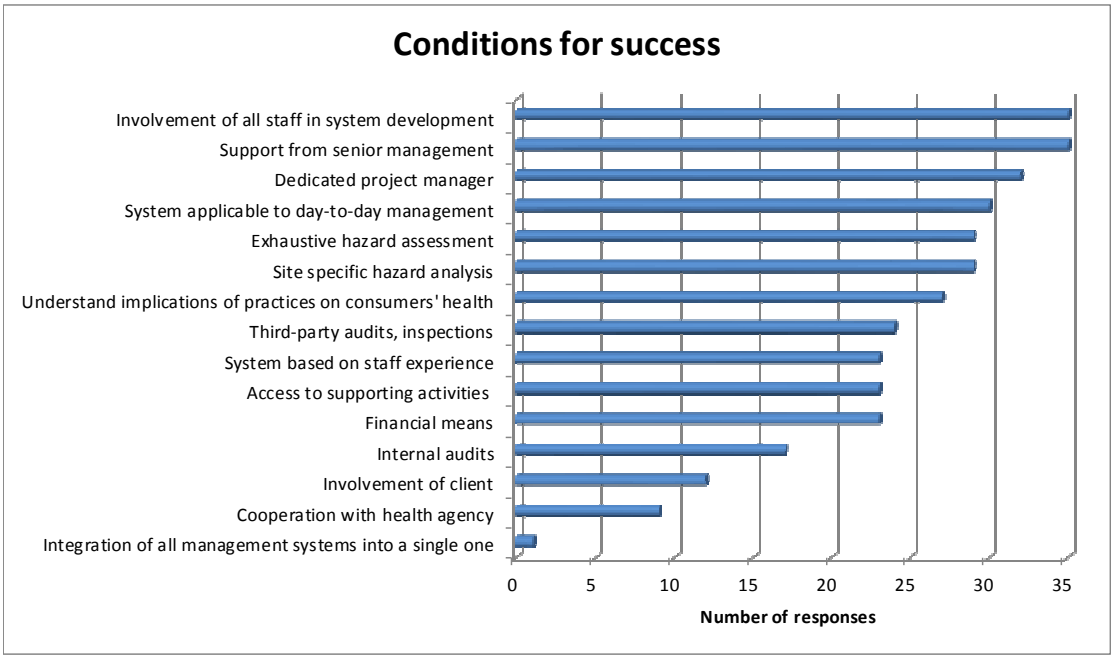


Figure 4 Conditions for a successful implementation of an efficient WSP (coefficient 2 for major conditions)

Conclusions

The results of this survey demonstrated benefits in terms of image of the company and confidence of clients and health agencies. The main benefits however consisted of a better control of hazards (especially new hazards that were previously overlooked) and of the treatments steps which are the most important for water safety (the critical control points). In a significant number of cases, a decrease in the number of customers' complaints could also be observed, thus indicating an improved quality of service. As the progress achieved was essentially linked with unregulated contaminants, improvements in compliance rate were rarely observed after the

implementation of WSPs. It is supposed however that a better control of these contaminants, together with an improved process control, should result in improved water safety, and that the consequences on consumers' health could potentially be estimated by using epidemiological or quantitative risk assessment approaches. This is currently addressed in a second phase of the study. Many of the difficulties found in the development of WSPs were site-specific, but it is interesting to note that at the time the survey was conducted, getting certificates of approval of chemicals and materials for contact with drinking water from the suppliers constituted the major difficulty, whatever the geographical location. The observed time and costs for implementation were consistent with those mentioned in the literature, and amounted (in the case of certification according to the ISO 22000 standard) to an average total time for implementation of 12 months, an average Full Time Equivalent (FTE) for implementation of 10.5 man-months, and an average FTE for maintenance of 4 man-months/year. The implementation time and costs however seemed to be decreasing over the years, probably thanks to the experience gained over the time, and the implementation of a WSP in less than one year was achieved at several sites. The lowest implementation time and costs were observed in the case of a WSP implemented without certification (respectively 7 months and 4 man-months FTE). Guidelines for implementation, database of hazards and control measures, education and training programs, and sharing internal auditors were identified as the major needs in view of further deployments at new sites.

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