

**Travail de diplôme en vue de l'obtention
du diplôme en informatique**

**Travail de
diplôme**

CORPORATE BENCHMARKING :

**A practical study of an
online benchmarking service**

**Présenté à la faculté des sciences naturelles
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1. Introduction

Benchmarking is not a very old practice, but it is gaining popularity among large companies. Still, small and medium sized organizations do not really know what benchmarking is, how it is used and how it can help them improve several if not all their management and production processes. With the actual increasing use of the Internet in those types of businesses, the idea was to develop a free online service that would allow local companies to discover and even use basic benchmarking techniques.

1.1. Research Goals

After developing a first version of a benchmarking website as a university project and being very interested in this field of research, it was suggested to me to extend the work into a degree project. The idea was to develop a newly designed website with added function and then to test-drive it with a selection of companies.

The main goal of the present project is to develop a database with a web enabled interface to allow a sample of companies to make a self-evaluation of their performance based on previously defined indexes. Inspired by different benchmarking techniques and “standards”, those indicators represent different processes found in each and every company. The obtained result may enable them to improve the performance of basic management and production operations.

Obviously, the second goal is to get a selection of companies to answer the indexes and then allow them to use the results for benchmarking purposes. The sample was made among companies located in the Fribourg area and working in the fields of computer technology, electronics and telecommunication. To help them with analyzing the results, brief guidelines have been included on the website.

The final goal is to determine whether such a service may be of any use for companies such as the ones selected. After going through the whole benchmarking process, the companies were asked to fill out a small questionnaire to express their opinion on the concept. This was taken as being the main aspect of the project. The reasons for this choice were on one hand the popularity of benchmarking studies in bigger organizations and on the other hand the fact that an “easy to use solution” like this service may interest companies like the ones selected. This project could be the groundwork of a full featured self-benchmarking service.

1.2. Content of the Study

When determining the content of this study, three main aspects had to be taken into account. First of all, to be able to achieve such a study there is a need to acquire some background on the subject. This was achieved by going through various books and websites. All of the gathered information was useful for the various aspects of the work that had to be completed. It helped a great deal in deciding which indexes to use on the website. Of course, it also provided good background knowledge on the subject.

The next two aspects of the study are the main objectives of the work. They include the realization of the website and the study in itself. For the website, the objective was to create from scratch a complete self-benchmarking portal. It required developing a whole new interface and also the underlying database. Both were inspired from the previous work that I had created as a third year project. Although having already worked with the tools used, this development part was interesting, challenging and fun to realize.

Last but not least comes the main part of the job. After making the selected companies work with the website they were offered the opportunity to express their opinion on the service. This is the aspect where you will find the primary objective of this degree work. Indeed, the purpose of it is to find out if a service like the one proposed by the portal could be useful for small and medium sized companies, and if they were able to learn something by answering the chosen indexes.

As a matter of fact the previous paragraphs are also the structure of this report; they describe exactly how it is built, starting off with a theoretical part, continuing with technical information about the website, and finishing with the preparation and the results of the study.

1.3. Steps of the Project

The development of this whole project took place over almost a year. After completing the third year project, time had to be taken to re-structure the concept and create something accessible to any company equipped with a personal computer and an Internet connection. Thus, the first step of the study was to elaborate a completely new website. It had to include the previously implemented services and new ones had to be added. After a couple of months of development and many weeks of error correcting it was more or less ready.

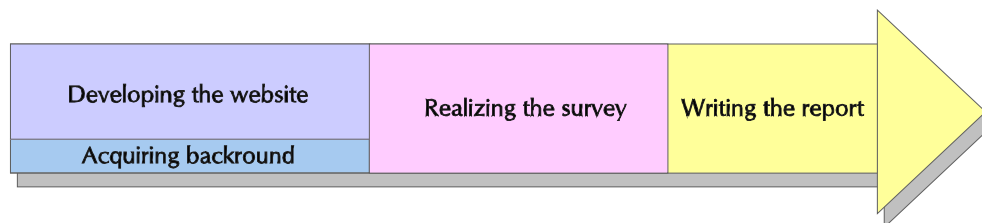


Figure 1 : Steps of the project

Simultaneously, the subject of benchmarking had to be mastered and studied thoroughly in order to be able to ask the right questions on the website. Time was taken to read reference material from books and especially from the Internet. Because the subject is quite new, most of the recent studies and numbers are only available through this medium.

The next phase can be described as the main part of the study which consisted of finding a way to get addresses of companies corresponding to a couple of criteria and then asking them to visit the website and answer the indexes. After having completed this step, they were asked to look at the results of the questions and to answer a short questionnaire about their experience with the service provided by the website.

To conclude the project, this report had to be written using all the available information. It is structured in three main parts, exactly like the development of the project. The first part, chapter 2, is the theoretical part about the benchmarking. It explains how it works and what it can do for companies. The second part, chapter 3, presents the implementation of the website and includes a user reference manual. And finally, the last part, chapter 4, presents the study in itself and the results obtained by the analysis of the answers.

2. Benchmarking

“The search for industry best practices which lead to superior performance”.

Sylvia Codling, Best Practice Benchmarking

2.1. Presentation

The benchmark is a performance or a functional objective that allows achieving a level of quality, realization, costs and speed.¹ This definition can be detailed by including an additional internal constraint. To achieve good benchmarking, the process, the product or the service has to be measured against the one proclaimed as being the best. In addition to a systematic evaluation of business performance, the other goal of benchmarking is the identification of best practices.² Hence, any good definitions of the benchmarking will have one common point, giving objectives.

This approach must enable any manager to define objectives and realistic actions that have to be engaged to be the “best of the best” in a reasonable time and then to keep that advantage.

Mohamed Zairi defines the use of benchmarking as: “Benchmarking is a trigger for performance measurement. It is not measurement itself but a process for establishing degrees of competitiveness and inducing action for closing any identified gaps.”³

First of all benchmarking is a process. So being, it is a series of organized tasks (or steps). It is even a continuous process because it is here to measure and compare. The goal is to choose various key measures of an organization and to compare them with the ones from organizations considered to be the best in their particular field. In some cases it is even possible to look at organizations that just have the same goals and objectives.

¹ [Balm 94, page 15]

² [Kueng/Krahn 99]

³ [Zairi 96, page 436]

From being an activity in relative isolation at its beginning, benchmarking was extended as a strategic quality tool to all aspects of business and progressively integrated into the management process. The first company to compare itself to the best in its market was Xerox. In the late 1970's, they realized that their Japanese competitors were able to sell their product far cheaper than Xerox could manufacture them. This led the management team to make comparisons in terms of unit manufacturing costs, manufacturing methodologies, time to market and so on. The conclusions of the study were taken into effect and, by 1980, it was a revival for Xerox.⁴

2.1.1. Benchmarking Techniques

Today, benchmarking is the continuous process of measuring products, services, and processes against the strongest competitors or those renowned as world leaders in their fields. In fact, benchmarking is very much an opportunity for an organization to learn from the experience of others.⁵ To help managers, there are four different types of benchmarking to choose from:

a) Competitive Benchmarking

It can be used as a way of informing people how badly or how well they are doing against direct competition. This technique is not always easy to deal with because it is sometimes hard or even impossible to obtain information on competitive process or targets.⁶

⁴ [Codling 92, page 3]

⁵ [Zairi/Leonard 94, page 26]

⁶ [Zairi/Leonard 94, page 47]

b) Functional Benchmarking

It compares specific functions like distribution, logistics, service, etc. with best-in-industry and best-in-class. One major advantage of this approach is that it is easier to gain access into non-competitive organizations as it is less threatening and there is also a greater likelihood that a two-way partnership can be forged with a greater potential for learning.

c) Internal Benchmarking

For many companies, an intensive internal search is the starting point for any benchmarking exercise. It is the continuous effort of establishing good practice in the various operations of the overall business.

d) Generic Benchmarking

It is similar in many aspects to functional benchmarking except that it focuses on multifunctional business processes.

2.1.2. Available Reference Models

Process reference models integrate the well-known concepts of business process reengineering, benchmarking, and process measurement into a cross functional framework.

Because benchmarking is a continuous process, it doesn't have standards or labels to ensure that an organization, or more specifically a process, has been benchmarked and improved. However there are organizations that provide models and frameworks to help companies introduce benchmarking in their management structures. Here are a couple of them:

Malcolm Baldrige Quality Program (www.quality.nist.gov)

The Malcolm Baldrige Quality Program provides a set of self-assessment tools to evaluate and improve management processes in such fields as business, health and education. It is based on a set of seven criteria (Baldrige criteria) that guide an organization through the whole process. They provide a “proven road map for performance improvement” to quote a member of the Baldrige panel of judges.⁷



Figure 2 : Malcolm Baldrige National Quality Program Model⁸

SCC SCOR Model (www.supply-chain.org)

The Supply Chain Operations Reference-Model (SCOR) was developed and endorsed by the Supply-Chain Council (SCC), an independent non-profit corporation, as the cross-industry standard for supply-chain management. SCOR is based on five distinct management processes: plan, source, make, deliver, and return. It is a model that provides a language for communicating among supply-chain partners. It will accurately

⁷ [MBNQAP 02]

⁸ [Baldrige 00]

reflect how a supply-chain's configuration impacts management processes and practices by describing, measuring and evaluating it.⁹

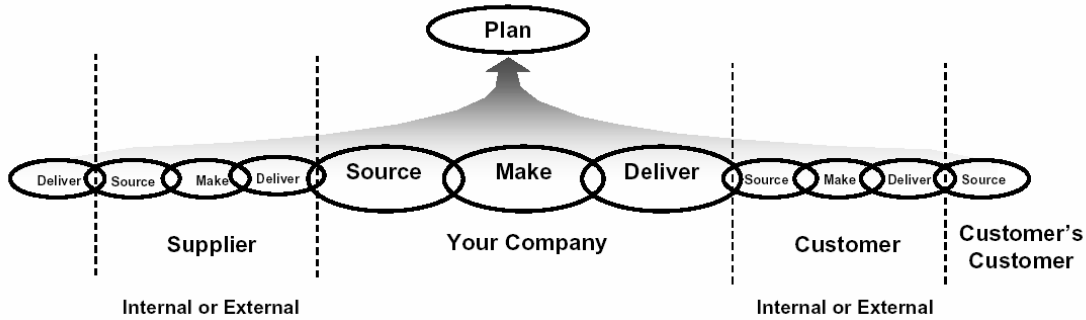


Figure 3 : SCC SCOR Model

European Foundation for Quality Management (EFQM)

The EFQM has developed a model that has been approved and used by several organizations. The EFQM Excellence Model is a practical tool to help organizations establish an appropriate management system by measuring where they are on the path to Excellence, helping them understand the gaps, and then simulating solutions. The EFQM is committed to researching and updating the Model with the inputs of tested good practices from thousands of organizations both within and outside of Europe.

The EFQM Excellence Model is a non-prescriptive framework that recognizes there are many approaches achieving sustainable excellence. Within it, there are some Fundamental Concepts which underpin the EFQM Model: Results Orientation, Customer Focus, Leadership & Constancy of Purpose, Management by Processes & Facts, People Development & Involvement, Partnership Development and Public Responsibility.

⁹ [SCC 02]

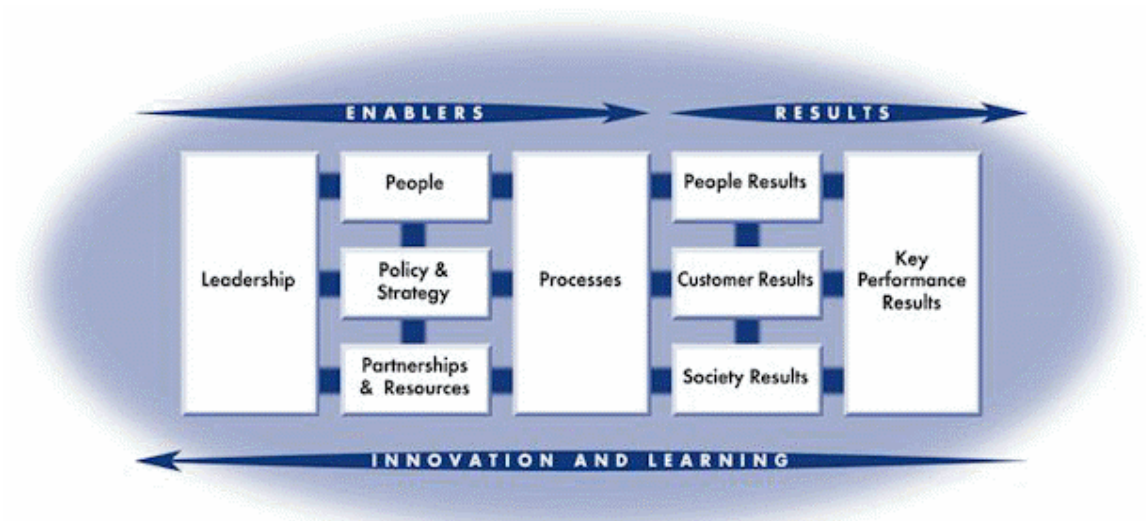


Figure 4 : The EFQM Excellence Model

The Model's nine boxes, shown in figure 4 represent the criteria against which to assess an organization's progress towards excellence. Each of the nine criteria has a definition which explains the high-level meaning of that criterion. To further develop the high-level meaning, each criterion is supported by a number of sub-criteria. They pose a number of questions that should be considered in the course of an assessment.¹⁰

This is a very brief presentation of the EFQM Excellence Model. More details will be given in the next chapters of this report.

¹⁰ [EFQM 02]

2.2. Use of Benchmarking

It is strongly believed that successful benchmarking practices are only the result of choosing carefully the right methodology¹¹. However, although being a tool, the process of benchmarking is very difficult to apply. It challenges the culture of work and scientific practices and methodologies in place. Hence, successful outcomes are heavily dependent on the presence or absence of a commitment to continuous improvement.

The best way to explain how benchmarking can be used is by taking a look at one of the best known and documented methodology. It was developed by Robert Camp for Xerox. It entails five phases involving ten steps.¹²

Planning

1. Identify what is to be benchmarked.
2. Identify comparative companies.
3. Determine data collection method.

Analysis

4. Determine current performance 'gap'.
5. Project future performance levels.

Integration

6. Communicate benchmarking findings and gain acceptance.
7. Establish functional goals.

Action

8. Develop action plans.
9. Implement specific actions and monitor progress.
10. Recalibrate benchmarks.

Maturity

11. Leadership position attained.
12. Practices fully integrated into processes.

¹¹ [Oakland 93, page 182 & Zairi/Leonard 94, page 31-63 & Codling 92, page 109-125]

¹² [Zairi/Leonard 94, page 52]

Many different methodologies exist and they all have their advantages and disadvantages. Their comparison suggests that there are many similarities between the different approaches used. The slight differences encountered suggest¹³ :

- perhaps: better clarity,
- explicit focus on each criteria,
- logical progression, and
- completeness.

However, in general they all obey to the same logical procedure as it is clearly shown in the Xerox example presented previously in chapter 2.1.

Sylvia Codling¹⁴ developed another methodology that covers the essential aspects of theory but is very practical in nature. In principle, it works in almost the same way as the one from Xerox. It is essentially strategic in focus, but once the critical success factors chosen, the area is broken down in a similar fashion to the process/operational level and thus critical processes are identified for benchmarking.

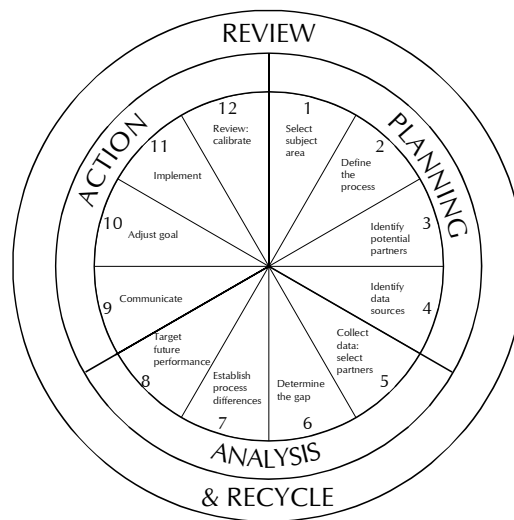


Figure 5 : Codling's benchmarking process operational steps¹⁵

¹³ [Zairi 96, page 442]

¹⁴ [Codling 92, page 46]

¹⁵ [Codling 92, page 47]

2.2.1. Planning the Benchmarking Process

Benchmarking provides organizations with a focus on the external environment and an emphasis on increasing process efficiency. In the present climate of dynamic change and fiercely competitive markets, both of these are essential for survival.¹⁶

Any organization should be conscious of its mission, of what it seeks to achieve and what mechanisms it uses to make sure its plans are on course.¹⁷ When a company wants to benchmark its management, it is not sufficient to look only at the product. It is necessary to explore the tangible and intangible factors which when combined produce a superior performance, and also involve in the process the people most directly concerned. People who have been benchmarking for any length of time confirm that significant and early gains result from this analysis. In the current complex dynamic fast-changing environment, companies must all aim at superiority in their core activities in order to survive. To develop a good benchmarking strategy, they have to start with¹⁸:

- the purpose of the organization;
- a set of values;
- a mission or a vision;
- objectives;
- strategies for achieving critical success factors;
- measures of progress on achieving them;
- action plans leading to desired business results.

¹⁶ [Codling 92, page 13]

¹⁷ [Zairi/Leonard 96, page 43]

¹⁸ [Zairi/Leonard 96, page 43]

When wondering at what time to use benchmarking, the best answer would be that it is an uninterrupted practice that companies have to use as part of the process of continuous improvement. This means that whenever they seem to be a little out of focus regarding their development, companies should study the possibility to analyze thoroughly all their production, distribution and management processes, just to name a few. Furthermore, they should never forget that the search of best practices is a continuous process.

Objectives	With Benchmarking
Becoming competitive	<ul style="list-style-type: none">• Understanding of competition• Ideas from proven practices
Industry best practices	<ul style="list-style-type: none">• Many options• Superior performance
Defining customer requirements	<ul style="list-style-type: none">• Market reality• Objective evaluation
Establishing effective goals and objectives	<ul style="list-style-type: none">• Credible, unarguable• Proactive
Developing measures of productivity	<ul style="list-style-type: none">• Solving real problems• Understanding outputs• Based on industry best practices

Table 1 : Reasons for benchmarking¹⁹

2.2.2. Data Collection Approaches

There are various types of data collection techniques and methods. They can consist in a long distance phone call, but also in meeting someone in person. Among the established ones we will take a closer look at seven of them.

¹⁹ [Oakland 93, page 181]

Internal

The service engineers, salespeople, and others are only few of the many potential sources of valuable information available directly inside the organization.

- People or equipment utilization reports.
- Reports or records form material usage and review.
- Field or salesmen's reports.
- Analysis of credit notes, warranty claims, etc.
- Analysis of rework, repair, replacement, or refund records or authorizations.
- Salaries and wages analysis.
- Production or operations costing reports.
- Scrap reports.
- Travel expenses claims.
- Inspection, check, test, and verification records.

Public domain

Sources include newspapers, magazines, trade publications, advertisements, company reports, patent records, university and business school research papers or organizations like the European Foundation for Quality Management (EFQM), etc. Not only can all of those provide subject matter information, but they can also create direct contacts with other organizations and thus allow access to complete researches.

Mail surveys

By this means, relatively complex questions can be asked and respondents can complete them when they have time. The risks with this method are shortness in obtaining clarification of any aspect of the survey, the sample returned may not be representative and the response rate is frequently low. Those disadvantages can be reduced by the use of the Internet. Each question can be linked to a precise description page and the response rate can be increased by keeping the surveys simple and easy to answer.

Personal interviews

Although this is sometimes difficult to arrange and can become quite expensive, it is however the best means of understanding data as it is collected.

Telephone interviews

This method has a good speed of response, the possibility to ask for clarification, and relatively low cost. As an extend of this technique, a videoconference allows not only to speak directly with the person concerned but also permits the use of visual aids.

Group interviews

Due to the highly interactive nature of the exercise, this method requires a very skilled facilitator.

Reverse engineering

Purchasing competitive products and systematically taking them apart can be extremely useful for benchmarking product cost, quality and design practices.

In general, more than one method can be used. But the requirements of the project should determine the best means of collecting the necessary information.

2.2.3. Benefits and Drawbacks

When studying the goals and procedures of benchmarking, we can see that it has proved very helpful for an organization but that it can also induce some drawbacks. Let us now take a look at some of them.

Because benchmarking improves the processes of an organization, it can naturally and significantly reduce waste, rework and duplication. It also increases awareness of what you do and how well you are doing it. By looking very closely at all the processes and understanding them, benchmarking leads to more effective management and helps set attainable targets. Thus it also identifies what to change and why. The external point of view that benchmarking provides to managers, enables the organization to learn from the outside and to better compare its performances with its competitors'.

Of course, benchmarking is supposed to enhance one organization's overall competitiveness. But it can also have some pitfalls or drawbacks that may disturb the whole benchmarking process or, on the other hand, that may bring to attention problems inside the organization. For example, the most commonly experienced pitfall is insufficient commitment. This problem can be seen from two different angles. The easiest conclusion would be that the people requested to do the benchmarking were not really involved in their task. But on the other hand, it can be seen as problem the organization has to concentrate upon.

Other pitfalls include attitude problems like insufficient planning or failure to go further and understand the flow, not linking benchmarking to a process. The thus obtained vague results will not be of any use.

2.3. The Indexes

To be able to evaluate its results and compare itself to others, an organization has to understand and then to determine carefully the measurement system that will be used as "framework". Those measures have to be sufficiently general to make sense for the organization and its benchmarking partners, but they also need to be very specific in order to produce interesting results. At the beginning, the choice can be made by using measures that the organization already uses. To help them choose, there are a couple of widely known tool sets that are inspiring.

In chapter 2.1.2., different benchmarking models were presented. Those models not only explain benchmarking techniques but they also propose indexes, not in a sense of concrete questions but as subjects that need to be covered by the benchmarking process. This paper focuses on the EFQM Model, because it inspired the practical part of this project.

The EFQM Excellence Model is based on eight fundamental principles. Attaining a level of excellence requires total engagement by the managers. Moreover, they have to fully agree with all the concepts. Those concepts are the following :²⁰

- **Result orientation**
Balancing and satisfying the needs of all relevant stakeholders.
- **Customer focus**
The customer is the final arbiter of product and service quality.
- **Leadership and Constancy of purpose**
Behavior of an organization's leaders creates a clarity and unity of purpose.
- **Management by Process and Facts**
Organizations perform more effectively when all inter-related activities are understood and systematically managed.
- **People Development and Involvement**
Full potential through shared values and a culture of trust and empowerment.
- **Continuous Learning, Innovation and Improvement**
Management and sharing of knowledge within a culture of continuous learning.
- **Partnership development**
Mutually beneficial relationships.
- **Public Responsibility**
Ethical approach.

²⁰ [EFQM 02]

The whole model is based on a technique called RADAR, which consists of the following elements: Results, Approach, Deployment, Appreciation / Evaluation and Revenue. The Model also proposes an auto-evaluation method that consists of a global, systematic, methodic and regular review of the activities of an organization. The eight fundamental principles can be used as categories for measures. This kind of pre-selection is very useful to determine which questions have to be answered in the benchmarking process.

It should not be forgotten that good benchmarking combines a measurement of quantitative and qualitative data. A means of deriving numeric comparisons from visual or perceptual information is therefore required to determine what else may account for performance gaps. For each tangible comparison, such as “better working atmosphere” or “more satisfied customers”, indicators can be found from which numeric outputs are derived.²¹

2.3.1. The Choice of the Indexes

The set of measures can include indicators relative to general fields like finance, technology, planning or performance measures. Moreover, it is important that this set includes measures on quality and customer satisfaction. Whatever system is chosen, the important aspect is that it has to be relevant and accepted by all the people participating in the operation.

From the “categories” described in the previous chapter, we can derive subcategories that can then be used as a center of interest for a part of our evaluation. For example, if we take the one about leadership, it is based on the way in which each leader implicates himself in the study by motivating the team and then by implementing the results of the benchmarking. This is an area that also has to be tested during the process. It can be determined by looking at motivational aspects of the management, at the way leaders work with other processes of the organization or at their responsibility in results.

²¹ [Codling 92, page 86]

In the chapter about the project itself, more explanations will be given about the way to choose indexes. It will especially explain how the ones for the project were chosen and also why.

2.3.2. Analyzing the Indexes

The definition of benchmarking says that we measure processes of one organization to achieve excellence. This means that, when trying to analyze the ones chosen for the study, we have to keep in mind exactly what we are looking for. There can be several different answers to that question but the two main ones can be compared by taking into account the time factor. Actually, the first one is part of the very definition of benchmarking, the purpose of being the best of the best. This means comparing an organization with its competitors at a specific moment.

But in a sense, benchmarking can also be used as an internal tool to enhance performances inside the organization itself. This can be done simply by making the same study several times (every three months for example), and then by looking at the evolution of the results.

2.4. The Results from Benchmarking

Now that all the benchmarking process has been done, it is really comes down to considering the results and weighing them against the present situation and the aimed for goals. There is no magic formula to do this. Deep reflections are needed in order to be able to consider and apply improvements. This part of the process is very important, in order to ensure that the use and application of what has been learned will be a success.

The crucial point when presenting the result of the whole operation is to present it in a clear and complete manner. If this is not the case, part of the work can be lost. Given that the human nature does not really respond well to changes, it is important to make all the participating people understand exactly what information the operation provided and how changes will be applied. The objective is here to make everybody become enthusiastic about it or at least make them accept it. To succeed, it is important to divide this process in two phases. First the managing team will have to be informed, because they are the ones allocating the resources and applying the changes in the organization, and only later, the people on the field that are concerned by the changes.²²

When communicating the results, experience has shown that the oral way is to be used whenever possible. It allows for real time questions. The communication has to be structured around a couple of key points:

- a description of the benchmarking process and its analysis;
- a short version of the results obtained and recommendations;
- supplementary details on what was found and on conclusions;
- side information.²³

To maximize the impact of the presented information, it is recommended to use the following:

- clear graphs;
- lists of advantages and benefits;
- links between existing procedures and the planned ones;
- examples of other benchmarks in other companies;
- validate results by several sources.

²² [Balm 94, page 94]

²³ [Balm 94, page 95]

This basic understanding now forms the groundwork of many worldwide quality award models, which recognize the important role benchmarking can play in driving actions which lead to superior performances. It is important to notice that the participating companies are not only big multinationals but also small and medium sized companies. The most well known quality awards are:

- the Deming Prize (Japan);
- the Malcolm Baldrige National Quality Award (US)
- the European Quality Award (EFQM).

In chapter 4.2., more information will be given on how to analyze the results of a benchmarking study by describing how to work with the indexes chosen for the project. The important part is not to forget that benchmarking is a continuous process and that when changes have been applied, it still doesn't mean that the organization achieved being the best of the best. There are always possible enhancements.

2.4.1. Benchmarking and Total Quality Management

Total Quality Management (TQM) is an approach to improve competitiveness, effectiveness and flexibility of a whole organization. It is essentially a way of planning, organizing and understanding each activity, and depends on each individual at each level. For an organization to be truly effective, each part of it must work properly together towards the same goals, recognizing that each person and each activity affects and is in turn affected by others.²⁴ The methods and techniques used in TQM can be applied throughout any organization. The impact of TQM on an organization is mainly to ensure that the management adopts a strategic overview of quality.

²⁴ [Oakland 93, page 181]

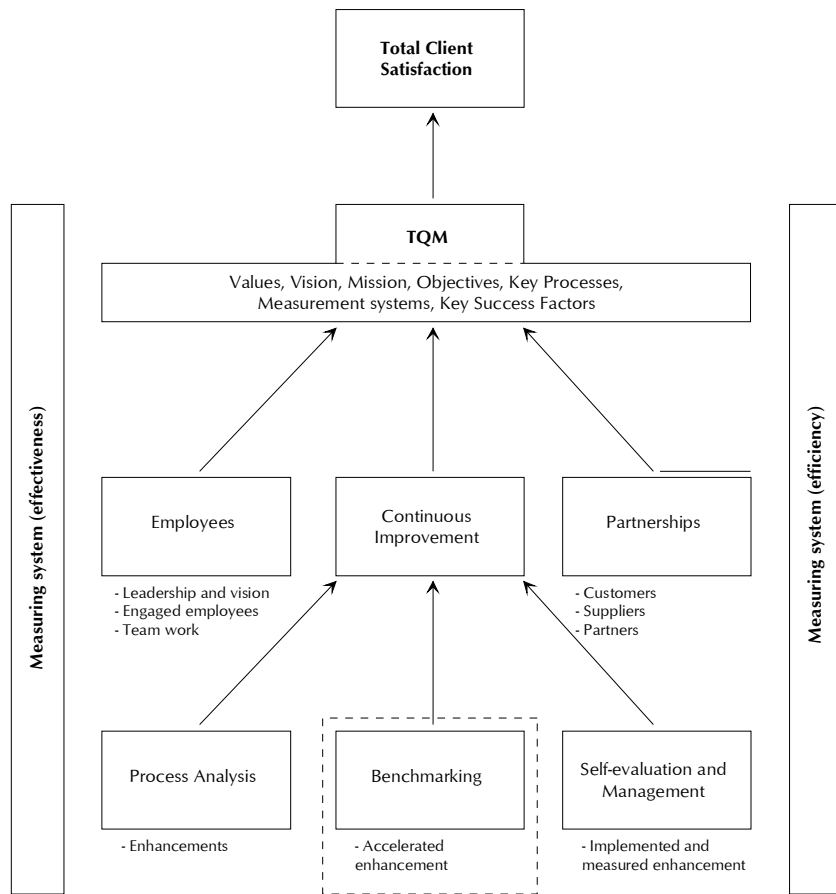


Figure 6 : Total Quality Management Model²⁵

As we can see in figure 6, benchmarking helps an organization to set goals. The goal of the system is to attain total customer satisfaction, either internal or external. Continuous enhancement is achieved by using tools like process analysis, benchmarking and control of changes with continuous evaluation of progress. This means that benchmarking is an important ground stone of Total Quality Management, they are complementary.²⁶

²⁵ [Balm 94, page 130]

²⁶ [Balm 94, page 131]

There is a great inter-dependency between TQM principles and benchmarking. In fact, they are an integral part of one another. One could trigger the birth of the other. Having TQM in place will enable organizations to use the art of benchmarking. There is no reason why starting with benchmarking should not trigger the introduction of TQM on a wider basis.²⁷

2.4.2. The Dangers

Because of various problems depending on the position in the market and the size of an organization, benchmarking will therefore differ from one to another. When the market position is not very comfortable and the organization experiences difficulties in comparison with its competitors, benchmarking needs to be introduced urgently. Therefore, the operation will require the use of lots of resources, commitment and company-wide contributions to achieve success. However, other companies are in a very comfortable situation and are therefore able to introduce benchmarking and learn from it without needing to achieve results so desperately.

During the whole process of benchmarking, there are some small aspects that have to be considered very carefully in every step. For example, when deciding which measurements to use, true indicators of performance need to be identified and a written summary of the purpose of the study needs to be prepared. In this early stage of preparation, let us consider some pitfalls that may occur:²⁸

- Subject selected not critical
- Too many subjects
- Quality, cost and delivery not considered
- Customer satisfaction not considered
- Too many or poor metrics
- No defined purpose

²⁷ [Zairi/Leonard 94, page 43]

²⁸ [Zairi/Leonard 94, page 200]

- Questions not directly related to the subject
- “So what” questions
- Questions difficult to answer for organization
- Insufficient planning

During the analysis phase, the following problems may occur:²⁹

- Analysis paralysis
- Over or under precision
- Inter-relationships and/or cause and effects not understood
- Not sticking to the subject

Just by looking at the whole benchmarking process, it is possible to see some other aspects that have to be taken into account. The group assigned to the operation has to understand the continuous nature of it. It should also be careful to link the benchmarking to processes, it is important to look beyond the obvious and understand the “how”. The work would be useless if the team does not concentrate on factors and processes that can make a difference. Ideally, they have to identify subjects linked to key business processes and not try to “change the world”. When handing out the results, they have to use clear means of communications. Hence, education about the whole operation has to be given to every department and links have to be made between corporate goals and activities in order to facilitate communication and relevance.

²⁹ [Zairi/Leonard 94, page 203]

3. Corporate Benchmarking Website

The Corporate Benchmarking Website is the main part of the presently described project. The research goals directly aim at how such a website can be of any use and how the interrogated companies may be interested in using it for their performance improvement. The “easy to use factor” has been made an important point so that the purpose of the service cannot be forgotten.

Companies that were invited to answer the selected performance measures had to complete three steps. First of all, after subscribing to the service, they had to answer the indexes that were presented on the website. Secondly, they had to look, a couple of weeks later, at the calculated results for those very indexes. Finally they were asked to answer a small questionnaire in order to determine if the service was useful and if it would be interesting to work with it for performance improvements.

Since the first version of the project, which was created as a third year project, there have been some enhancements. A couple of suggestions were made in the previous written project. They included the possibility to add graphs to the representation of the results, to enhance typing for the index, to include periodically changing questions and to improve security.

All of those enhancements were inquired in the development of the present project. Not only can the users see graphs of the calculated answers but those are also available to the administrator for checking the results obtained. The possibility to add typing to the answer field of the indexes - like percentage, days or amounts - was discussed. To make it easier, the description of an index is in fact going to include an explanation of the type of answer wanted. Because of the new purpose of the project, making the companies fill out a satisfactory survey, adding periodically changing questions was abandoned. Furthermore the security involved was thought to be sufficient for this type of project, even if tools to enhance it exist.

3.1. Presentation

The website is divided into two main parts : a client side accessible to all the invited companies and an administrative one used to manage the indexes, the users and the results. A short manual of how to use those two parts will be given in the next chapters.

First of all, it is important to note that out of a concern of usability and because the selected companies use different languages, the website has been developed in French, German and English. When users arrive on the website, they have the possibility to choose the language they are most comfortable with, as shown in figure 7.

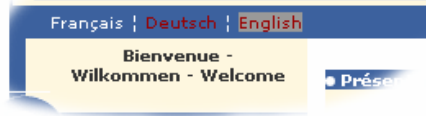


Figure 7 : Language selection on the homepage

Because the purpose of the website is, for the companies, to provide information and to compare them with the ones from others, it was decided to put on the welcome page a small notice about the use of those information. It basically says that no specific numbers will be given to other companies and that their use is strictly limited to the study. With today's concerns about privacy it is strongly encouraged to add that kind of notice to any website that collects information.

3.1.1. The Client

To illustrate the client side of the website, the example of a new visitor will be used. Once he accesses the main page, there are four possibilities for him to choose from: obtain information on benchmarking and on the indexes, register to the service or log into his account.

Because new users may not exactly know the purpose of the website, they are offered two different pages where they can get the necessary explanations. The first one is a little summary of what benchmarking is, how it can be used and what it can provide as a performance enhancement technique. This short presentation comes with a couple of links that can provide further information. The second reference page presents the different indexes used and their categories. It is user-friendly. At first, the user has to select the category of indexes he wants to get information on. When this is done, the page is reloaded and the measures belonging to that category are shown in the middle of the page together with their description. On the right hand side of the page, the user can still choose a different category which will result in reloading the page with the newly selected indexes (Figure 8). Those two pages are also available to a registered user from his account page without having to log out.

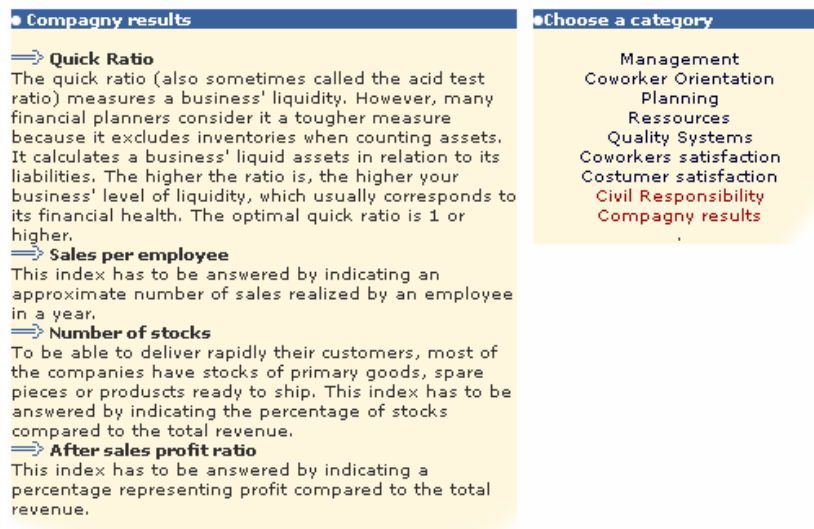


Figure 8 : Information about the indexes

If the user is interested in the service provided by the website, he can simply register to it. This is done by filling out a simple form. A few answers are mandatory. They enable the administrator to control and to manage the registered users. They include company name, name of the person in charge, e-mail, size and sector of the company and of

course, username and password. When the user clicks on submit, the form automatically checks all the answer to see if they are correct. For example, a small JavaScript script checks the validity of the email address. This means that it has to contain characters, a “@” sign, some more characters and a dot something at the end. Another check is performed on the server side. As the user’s information arrives on the server, it is compared with the one of the other users stored in the database. Should the company name or the typed username already exist, the registration process is temporarily canceled and the visitor sees an error page which tells him to try gain giving different details about himself.

If the visitor is already a registered user, he can access his account page simply by login in. If the information (username and password) provided are not correct, he is sent to an error page from which he has to go back and try again. Those values cannot be changed by him. If he has lost them, he has to contact the administrator to ask him for them.

The account Page

Once logged in, users are brought to their private account page. The menu is structured in five sections, as shown in figure 9. The first two are the two information pages that were also available when the user was not logged in. They have been previously presented in this chapter and are set up so that when visited, the user is not logged off from his account when he accesses them. The “My page” value in the menu enables him to simply go back to his personal homepage form any other page of the website as long as he has logged himself in at first.

The next links from the menu bar are related to the indexes included in the study and the benchmarking process. The user can first answer them in the appropriate section and then take a look at the obtained results. Finally, the website includes a short guideline on what to consider when comparing the results. Those different sections will be described more in details further in this report.

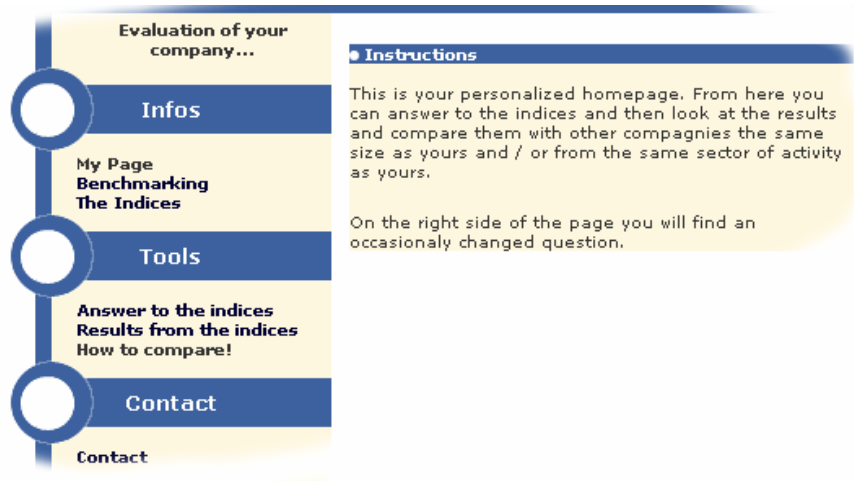


Figure 9 : User account menu bar and instructions

As shown in figure 10, the account's main page also enables the users to see the personal information they gave when they registered to the service. It can be changed at any time with the exception of the username and password that can only be changed by an administrator. The users are presented on the left side of the page with a link at the bottom of the box. To change his information, a user has to provide his correct username and password on the form provided for this purpose. If this is not done properly, the changes will not take effect and an error page will be displayed. In this case, he has to go back and try again.

The center of the page includes a small explanation of what the client can do from this point on. It simply summarizes the goal of the service and its functions.

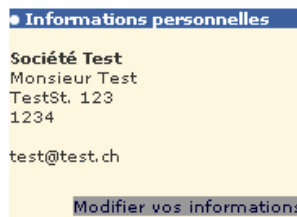


Figure 10 : Personal Information on account page

Once the study has started and a certain amount of companies have answered the indexes, a link to the opinion survey will be added on the page. The display of this link is done by having a Boolean switched from one value to the other by an administrator in the page. To avoid having multiple answers by the same company, the page is constructed in a way that once the user has completed the survey, the link disappears.

Answer to the indexes

Once he has access to the service, the first task of a new user is to answer the proposed indexes. To do this, he has to go on the page designed for this operation. It presents all the indexes available on the site in little boxes sorted by categories.

Each category includes multiple indexes which are always represented by a blue frame. That frame contains information like the name of the index and the provided answer. There is also a little icon showing whether the user has to answer it or if he already did, thus allowing him to modify his answer. The two different kinds of frames are shown in figure 11.



Figure 11 : Modify and Answer frames

In the frame, there is a variable link which allows two operations. If the index has not been answered yet it will display the word “Answer” and if it has, it will show “Modify”. When the user selects either link a new window pops up. It displays the name of the selected index, its brief description and a cell for entering an answer. When the user clicks on the button in the window (either “Save” or “Modify”), it disappears and the page with the list of indexes is refreshed to display the changes made. If the selected index has not already been answered, it will change attribute and be displayed as being

so and enable the user to modify the answer. Once the index has been answered, the user can still choose not to answer it by selecting the appropriate link in the pop-up window displayed by clicking on the “modify” link. The window can also be closed at any time by selecting the “close this window” link.

This part of the service has been improved from the previous version. Before, users had to answer all the indexes one after another and then go on to a special page to change the answers they gave. The new version not only allows doing this from the same page but also allows users not to answer all indexes and also to remove answers previously given. Those improvements make the service less constraining as well as more fun to use.

Results from the indexes

As soon as the user has answered a couple of indexes, he can view the results. This is the main aspect of the service and also the part of the benchmarking process where data have to be compared and analyzed. As discussed in chapter 2, Benchmarking has as a main objective the comparison of performances of one company with the ones from others. Thus, the result page shows a couple of interesting numbers.

First of all, the user has to choose the index he wants to study. This is done by selecting the appropriate category and then the index. To do this operation, the selection page is implemented with an automatically updated drop down menu. As shown in figure 12, once a category has been chosen, the second menu is updated with the indexes included in that category.

• Here are the results of the chosen index.

1. Choose a categorie :

Coworkers satisfaction

2. Choose an indice :

Les indices :

Les indices :
Employee Absenteeism
Employee well being practices
Leaving employees

Figure 12 : Selection of an index for results display

Once the index selected, the user is automatically brought to a new page where the results are displayed. To improve clarity, they are separated in three different parts. First is displayed the answer that the user entered. This allows him to better understand the averages that are given just below. The first average represents the number of “yes” or answers given by all the companies, which work in the same sector that answered the index, divided by their number. The second average is the same but focusing on the companies that are the same size.

Below those numbers is displayed a graph representing the answers. There are two cases to discuss here. It has been decided that some indexes were to be answered with a number representing a percentage, a number of occurrences, a number of days or an amount, and others by “YES” or “NO”. In the first case, the graph represents in pink the answer given, in grey the highest stored answer, in blue the average and in purple the minimum. As can be seen in figure 13, the graphs always come with a legend explaining the meaning of the colors.

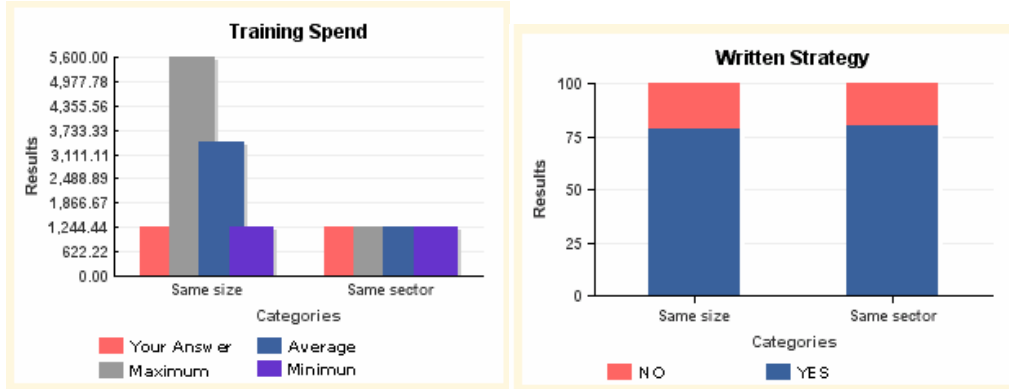


Figure 13 : Graphs generated with the given answers

For the second case, the graph only shows the proportion of “YES” (blue) and “NO” (pink) in percentage. Hence, the written results are given as number of “YES” compared with the number of companies who answered the index. Finally, it is important to note that both types of graphs are automatically generated by the server. This process will be explained in detail in chapter 3.2.4..

How to compare

The Corporate Benchmarking Website would be almost useless without a page on how to use the provided results. On the other hand, it is almost impossible to give the user a miracle technique to analyze his answers. There is no magic formula to improve performances in an organization. For that reason this page mainly tells the user that in order to make a good analysis of the numbers, he has to look at his answers and compare them with the averages, maximum and minimum given on the result page. This done, he should try to determine which way to go and what needs to be changed or improved to achieve better performances. The minimum and maximum can be referred to as limits, or border-line answers. They represent exceptions to the average. However they are also a big influence. It is therefore very important for the person in charge to consider those numbers and weigh them against their own answers and the calculated average.

There is also a difference in the analyzing part of the benchmarking process when looking at the indexes that are to be answered by “YES” or “NO” and the ones that asked for numbers, amounts or percentages. The response a company has to provide to such answers varies and does not necessarily mean that it should suddenly change its practices when a majority answered “yes”. Those aspects are briefly explained on the page. But then again, because there is no magic formula, it is mainly up to the person in charge to try to make the best conclusion out of the provided information. The problem still remains if other benchmarking techniques are used. So it is merely a mix of good sense and keeping in mind the background which is provided by the company.

3.1.2. Administration

The administrative part of the Corporate Benchmarking Website has three goals. They are all presented on the main page of the administrator’s account. They include tools to manage all the indexes, to control the users and to look at the result of the benchmarking process.

The administrator has a set of three tools available to him to manage the indexes. First of all, it is important to notice that the indexes are sorted by categories. That is why the tools, or more specifically the functions, are available for each one of them. The three functions are : Add, Modify and Delete. The “Add” function opens up a page where the administrator can create a new index that will be added to the selected category. To do so, he has to fill out the displayed form. He has to give a name to the new index, select a language, write a small description of the index and specify whether the index is a question answered by “YES / NO” or with a number. When he enters a new index, his task is to translate it into the three available languages. So he has to create in fact three new indexes, providing each time the different elements. When adding new indexes, the program beneath the page proposes a new index identifier. This number has to be the same in the three different languages in order not to confuse the system. Thus the administrator can use the proposed ID when entering the version of the index, but has to enter it manually when entering the others.



Figure 14 : The administration main page

The “Modify” function displays the same fields only three times, once for each language. Contrary to before, this time the fields are filled and the modified information can be saved by simply clicking on the “Modify” button. Finally, the “Delete” function opens up the list of index from the category followed only by a “Delete” button. After a security confirmation question, the administrator can delete an index from the database.

The second administrative function is the management of the registered users. Directly on the main page, two numbers are given : the total number of registered users and the number of them who answered to at least one index. Below that information a link opens up a list of the users sorted alphabetically and presented ten by ten. Those pages allow the modification of the username and password of any registered user. Their

second function is to delete the wrongfully or unwanted registered users. It can also be used as a reference for providing those data to a client who might have forgot or lost them.

The last available function for the administrator is to look at the results of the benchmarking operation. By selecting a category of indexes it is possible to see the results sorted first by sector and then by size of the presently conducted study (see figure 15). The values shown on the page represent either averages or numbers of “yes” compared to the number of companies who answered. By clicking on a sector or a size, the page is reloaded and a graph of the answers is shown on the right hand side of the page. For index answered by “YES” or “NO”, the graph shows the percentage of “YES” (in blue) compared with the one of “NO” (in pink). For the other indexes, the graph not only shows the average but also the maximum and the minimum stored answers. That information can be used to check the validity of certain answers in case someone did not fully understand the index and provided an answer totally out of proportion.

● Systèmes de qualité et divers processus	
Résultats de : ISO 9000	
<i>Moyennes par rapport aux secteurs</i>	
Industrie, métier, approvisionnement d'énergie	0 sur 2
Métier du bâtiment	3 sur 5
Distribution, Réparation, Hotellerie	0 sur 0
Traffice, Envoie de messages	0 sur 0
Banques, Informatiques, Services rendus aux entreprises	0 sur 0
Administration publique	0 sur 0
Enseignement	0 sur 0
Santé et affaires sociales	0 sur 0
Autres services rendus	0 sur 0
<i>Moyennes par rapport aux tailles</i>	
20 - 99	0 sur 3
100 - 499	3 sur 4

Figure 15 : Results available to the administrator

To ensure secure access to the administrative part of the Corporate Benchmarking Website, the privileged user has to enter a correct username and password. To make it a little trickier, he also has to enter a test value depending on a given one. The principle is very simple, he has to enter a number that is the subtraction of a known number by the given test number. To make the system safe, the known one has to be kept secret at all times, even if it can be replaced by a new one. This type of security measure is called challenge response access.

3.2. Implementation

In the development of such websites, there are different implementation options available. For this project, the combination of PHP and MySQL was selected. The creation of the database was done using all the different elements of the study, like the companies, the index, etc... To design the pages, the commercial market provides WYSIWYG tools (What You See Is What You Get) that allow easy formatting of the pages. The one chosen for this application was Macromedia Dreamweaver. A solution for generating graphics was found in the way of a PHP³⁰ class that allows drawing different kinds of graphs.

3.2.1. PHP & MySQL

PHP (Hypertext Processor) is an HTML scripting language created during fall 1994 by Rasmus Lerdorf, which works on the server-side. The first publicly available version was distributed in 1995. In 1997, the project went from being private to becoming a group work. Several parts of the language were re-written and it was known at that time as PHP 3. Today the version 4, which was optimized by Zend³¹, is distributed and support by many commercial products.

³⁰ [PHP 02]

³¹ [ZEND 02]

PHP includes the same functionalities as other CGI scripting languages, like collecting data, dynamically generating web pages or sending and receiving cookies. There is however a big difference between PHP and other CGI scripting languages as Perl or C. Instead of writing a program with numerous lines of command to show an HTML page, the developer can simply write an HTML page and include code inside it to realize a specific action. The PHP code is set between starting and ending tags which allow the server to switch to PHP mode.

What distinguishes PHP from scripting languages like Javascript is that the code is executed on the server. The client has no way of accessing the PHP code of the page he is watching. A webserver can be configured as having to consider every HTML file as a PHP file, thus no distinction can be made by users between a regular HTML page and a dynamically created PHP page.

One of the qualities of PHP is that it supports a large number of database systems. Developing a dynamic web page working in conjunction with a database is not very difficult with such a tool.

For example, MySQL³² is a database system that is often associated with PHP. MySQL is a system that is set to work fast, to be multi-threaded, multi-user, and also a robust database server. Unfortunately, there are some limitations and disadvantages that make it less powerful than other database systems available on the market. SQL is a standardized language which allows easy access, update and storage of information. For this project and for small web-projects in general, MySQL has proved to be sufficient.

It is fast and flexible enough to be able to generate logs and images. The principal objectives of MySQL are free availability and ease of use. Even if MySQL is still in the development phase, it already provides a set of complete and useful tools.

³² [MYSQL 02]

3.2.2. The Database

The whole Corporate Benchmarking Website is constructed around a MySQL database containing eight different tables. Each of them stores information relative to an element from the service, thus from the website. For example, the table called “INDICES” contains all the data regarding the indexes used for the study. Each row of the table stores a different index with its name, an identification number, a language identifier, a category number, a brief description and an “INFO” field which allows to define whether the index has to be answered with a number or with “YES / NO”. Below, figure 16 shows all the tables used to construct the database as well as all the fields they each contain. Moreover, the figure also shows the relations that exist between the tables.

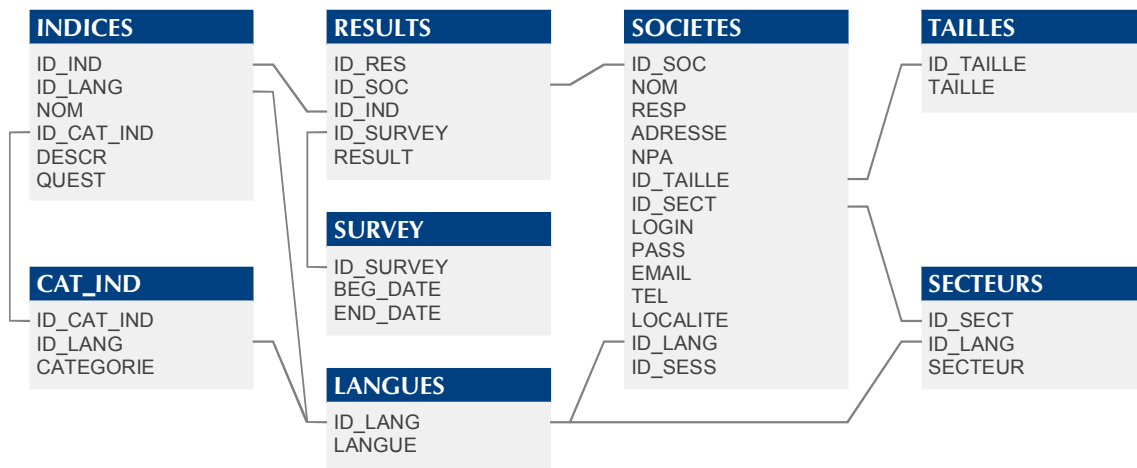


Figure 16 : Tables and relations in the database

The design of the database relied on basic techniques which allow preventing redundancy. As an example, in the table “CAT_IND”, which contains all the categories, instead of creating a different “CATEGORIE” (name) field for each language used, each category has in fact two primary keys (“ID_CAT_IND” and “ID_LANG”). This way, we can store the name of the categories in each language simply by specifying an ID which is then related to a table containing the different languages. For example, index

number 3 has three versions stored, one in each language. They all share the same identifier but are different because of the language identifier they use. The same technique is used for the table containing the sectors and the indexes.

There is one table that is included in the database which is not really used for this study. It is the "SURVEY" table. It was included in the project primarily to allow further use of the service. Actually, when a registered user enters an answer to an index it is stored in the "RESULTS" table. Automatically, the server appends to it a survey number corresponding to a time period. Those periods are stored in that "SURVEY" table and allow the service to be re-conducted several times without losing information from older periods. It is not used for this study because those periods are set for a year and the project only runs over the first two months of the year 2003. If we were to do the study again next year, we would be able to differentiate the results and might register an evolution in the answers given.

3.2.3. The Interface

To simplify the use of the service and to make the website accessible to anyone, efforts were put into developing a pleasant and attractive interface. As with the first version of the website, importance was given to clarity, simplicity and readability. In order not to waste any time, a template of the original homepage was created. Then, copies were individually designed regarding their own purpose and needs.

This made it easy to add PHP scripting to all of them in order to make the content dynamic. For example, because the website is available in three different languages, the menus are automatically changed by PHP. Moreover, the scripts are also implemented to seek information from the database. As an example we can take a look at the personal information displayed on a user's main account page (figure 10). The principle is the same when a user wants to display results from an index. The recorded answers are first retrieved from the database and then an average is calculated. This operation is

not only based on criteria like the sector or the size of a company but also on whether or not the user answered the question. Obviously, if a user did not answer an index he should not be allowed to look at the results. PHP cannot only retrieve data from the database but each time a user answers to an index, it does a simple operation to save the newly given answer. It is then available for any queries that he or any other user may make.

When a visitor first arrives on the website, he can at one glance see the important parts of it. At the top of the window, there is the name of the site and a couple of buttons that are in fact replicates of the items found in the menu. Underneath, he can easily change the language by a simple click. On the left hand side of the page, there is the main menu which allows unregistered users to visit a couple of pages.

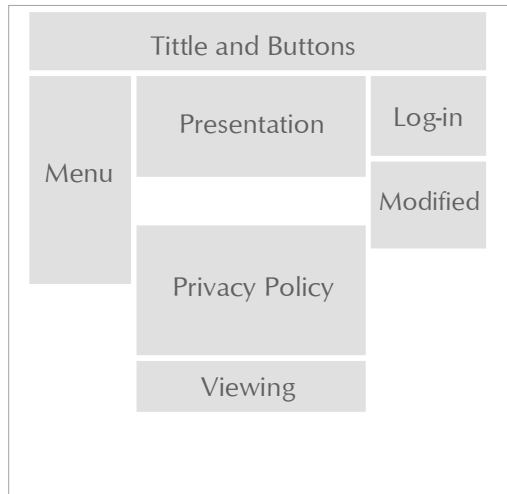


Figure 17 : The Homepage

The main area is divided into several little boxes, which each have a particular purpose. First there is a small presentation of the service provided on the website. Right next to it there is a box allowing registered users to log in. Below it there are other boxes which explain three aspects of the website. The biggest one gives information on the privacy policy used and enforced by the service. The three others are just there for

technical reasons. They explain which tools were used to create the website, how it is best viewed, when it was last modified and offer to save the page in the user's bookmark list. This scheme of boxes is used throughout the whole site.

Finally, it is important to notice that the upper part and the menu vary from page to page and especially between a user account and the "free" part. This is done by sending the user's session ID with each link once he has logged in, thus allowing PHP to generate a different page.

3.2.4. Generating Graphics

In two parts of the website, graphics are generated automatically from the numbers stored by the answering companies. There is a result page for the users and another one for the administrator. This process is done through a module that works over PHP, called GD³³. It allows developers to make PHP generate any kind of graphics using easy to implement techniques.

In the case of this website, I used a graph PHP class freely available on the Internet. It includes functions to draw line-, point-, and bar-graphs. The library is free software that can be redistributed and/or modified under the terms of the GNU Lesser General Public License. Basically, what this class does, is provide the developer with a method that generates graphics with the use of the GD module. There is a series of parameters that can be used to specify different aspects of the graphs.

A couple of modifications were added to the distributed class. Because the generation of graphics did in fact directly create the image on the output of the webserver, it was difficult to include it into a previously designed page. To solve the problem, the class now creates a file for each generated picture. It is stored in PNG format in a folder of the website. Another added option was the ability for the class to name a file

³³ [Leierer/Stoll 01]

automatically by actually using the number of an index and the ID of the company which is requesting the picture. In the administrative part, the files are named using a character, the category and the number of the index.

3.3. Housing the Website

To make the Corporate Benchmarking Website easily accessible to all the invited companies, a domain name was bought and an account on local provider's server was created. This means that the service is available from anywhere in the world with an easy to remember address.

The created account has enabled PHP scripting instructions and an available MySQL database. Because of the different versions of the available webservers³⁴, it was not easy to make the service compatible between the one that ran in local and the remote server. There were problems with the version of Apache that could easily be arranged. On the other hand the PHP module caused more difficulties. The part of the website which generates the graphs depends on specific versions of PHP and the tools that are included in it. For example, the picture generating module from PHP, GD, uses different types of fonts depending on the installed version. And, as expected, problems arose when running the graphic generator for the first time.

Nevertheless, after solving all the above problems, the website works fine now. The advantage of not putting the website on the university server is that the domain name makes it easier to contact than when having to enter a never ending address. As explained in chapter 4.3., this turned out to have an unwanted effect on the credibility of the study.

³⁴ [Apache 02]

3.4. Future Development

Even if this is the second version of the project, there are still a couple of improvements that might prove useful. One of them, that nearly made it to this version, is the possibility for companies to print out, in the form of a PDF file, a summary of all the results from the indexes they answered.

Because the website can be used with any type of questions, another feature that could turn out to be very useful when starting a new study, is the possibility to automatically inform the user by email, as soon as sufficient companies have answered the questionnaire and that it is now worthwhile to go back and take a look at the answers and try to come to some conclusions.

Added features could be developed regarding the technical background of the website. For example, it would be nice for frequent visitors to enable the website to remember their usernames and passwords so that they would not have to enter them each time they visit. Added security features could also be useful, although the system is safe enough regarding the type of information collected.

4. The Study

This chapter provides information on all the various aspects of the study. Starting off with a general presentation and a subchapter about the choice of indexes, it concentrates on analyzing the use of the developed online benchmarking service. It provides information on the participation of the companies, their appreciation of the service and the website, and on future developments that could be implemented. Each aspect includes an assumption in the form of a conclusion.

4.1. Presentation

For all the companies interviewed, the study took place in two distinctive parts. First of all, their task was to try out the service. They had to answer some indexes and then reach conclusions with the calculated results. Their second task was to answer a small survey in which they could basically give their opinion on the service and the website.

To make this study meaningful, it was chosen to interrogate a specific number of companies working in the same field and in the same geographical region. The first idea when planning this job was to ask all of them who worked in computer technology in the “canton” of Fribourg. The reasons for that choice were that they were thought to be the ones having easy access to the Internet and, what more is, that they might more likely be open to new management techniques like benchmarking.

To broaden the field and also to have a sufficient number of companies to invite, the final choice was not only to take companies working in the computer market but to add the ones that had related work fields, like telecommunication and electronics. The total came to about one hundred companies, 97 to be precise. They were all sent a letter³⁵ to present the project and to suggest they take part in it.

³⁵ Copy of the letter in annex 1

The website created for this study was designed to be changed depending on the chosen field. For example, to be able to differentiate the companies, the number and the names of the specific activities and sizes of the companies can be modified very easily. This implied not using the generic types of businesses but to adapt the sectors to the sample. Other criterion, like the total revenue, could have been chosen, but for this benchmarking project fields and sizes were appropriate. The following specializations were chosen :

- Computer network installation
- Computer knowledge teaching
- IT consulting
- Hardware/Software selling
- Software development
- Electronics
- Telecommunication

The same process was used to adapt the sizes of the companies to the sample. These are the ones used for the study :

- From 1 to 15
- From 16 to 250

Although almost 100 companies were invited to take part in this study, we can already say that not all the sectors will have the same number of participants. For example, the number of organizations which work in the consulting field is far more important than in the Telecommunication field. This means that not all the companies will have the same opportunity to benchmark and compare themselves with others. Nevertheless, it will still be of interest for them, because if there is a good answer rate, there might be at least half a dozen competitors to level with in most fields.

4.2. Choice of the Indexes

Apart from choosing the most appropriate sample of companies, the other big step of the project was to select interesting and easy to answer indexes. To help with that task, I relied on several useful examples found in various articles:

- Cambridge University Brochure 2000; Small Business Service : Closing the Gap, *Top or bottom? Average or excellent? Leading or lagging? How do you compare with the test?*
- Baldrige National Quality program 2000; National Institute of Standards and technology, Criteria for Performance Excellence
- E-Trade Publication; Developing Performance Metrics – University of California Approach

Those articles talked of many different indexes designed to analyze most of the routines in a company. Because this study works with the processes described by the European Foundation for Quality Management, some work had to be done to adapt their classification and to make them relevant for benchmarking. This allowed me to present to the companies not only indexes they had to answer, but also a good and well thought through segmentation of business processes, which may be new to them. In fact, we can be pretty sure that most of the companies that were invited maybe already knew or worked with seven out of nine of those processes. In most cases, the reason for that consists in a problem of naming the different procedures, not of using them.

In the next part of the report you will find the complete list of all the indexes used for the study. They are classified by categories and always include the brief description that was used on the web site to present them to the users. The main purpose of those explanations is to make sure that the companies answer the indexes correctly. For example, they always include a sentence which the user what kind of number they are to type in the answer field. Indeed, the service would not be very efficient if a client answered giving a percentage when the question asked for a number of days.

The study

The table below also includes information that is not visible to the users. In fact, the “type” field is not useful to them, but is very important for the dynamic (PHP) part of the web site. Having this field, enables the server to display either a blank field when a number has to be inputted or a scroll down menu when a choice has to be made between “yes” or “no”.

NAME	DESCRIPTION	TYPE
Management		
Guiding principles for management	In the management functions of your company, guiding principles allow a better organization of the whole management process. By describing precisely all its functions it improves organization. This index has to be answered with yes or no.	Y/N
Control of management systems	Even when having a management system with guiding principles working satisfactorily, it is sometimes useful to check if everything is going the right way. This index has to be answered by indicating the average number of controls done each year.	NUM
Marketing expenditure	Advertisements, catalogs of products and appearances in the medias are important elements that help a company to be known by new customers. This index has to be answered by providing a percentage devoted to marketing depending on the annual revenue.	NUM
Coworker Orientation		
Training expenditure	This index has to be answered by providing an average annual amount used for the training of coworkers.	NUM

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Training time for new employees	When recruiting new employees, a training period is required. This index has to be answered by indicating an average number of days devoted to this training for every new employee.	NUM
Training time for existing employees	Once on the payroll, an employee can be required to follow a complementary training. This index has to be answered by yes or no depending on if this can be the case in your company.	Y/N
Planning		
Written strategy	It should not be mistaken with the guiding principles. What is meant by written strategy is a simple printout of medium and long time goals. It does not have to be very precise but should simply consist of a list of goals like progress of sales, development, future investments, etc... This index has to be answered with yes or no.	Y/N
Number of employees per project	This index has to be answered by indicating an average number of employees working on the same project during its fulfillment.	NUM
Achieved goals	When determining its strategy, a company has to set goals. This index has to be answered by indicating the percentage of attained goals compared to the ones set the previous year.	NUM
Resources		
IT systems cost	The abbreviation IT (Information Technology) includes all computers and computer accessories, phones and faxes as well as the costs involved. For example, phone bills have to be taken into account This index has to be answered by indicating an average monthly amount.	NUM
New employees	For this index you have to indicate the average number of new employees per year.	NUM

Quality Systems		
ISO 9000	ISO 9000 and ISO 9001 are quality standards that stand for good organization in a company. This index has to be answered with yes or no.	Y/N
Improvements	No matter what the activity, technological improvements always allow to propose new products or services. This index has to be answered by indicating the average number of novelties proposed to existing clients on a yearly base.	NUM
Rewards for high performance	Frequently, employees of a company are rewarded when achieving good performances. Is this the case in your company? This index has to be answered with yes or no.	Y/N
Coworker Satisfaction		
Employee absenteeism	During a full year, every employee is absent for a couple of days. Here we are especially interested in the days where an absence is unjustified and/or unexpected. This has to be answered with an average yearly number of days per employee.	NUM
Employee well-being practices	Certain companies create little spaces to allow their employees to enjoy their breaks. They may create a small cafeteria where employees can take their coffee. Moreover, certain companies arrange their offices so that the temperature is always pleasant. Did you establish practices for your employee's well-being. This index has to be answered with yes/no.	Y/N
Leaving employees	Whether being fired or leaving on their own, this index has to be answered by indicating the yearly average number of employees that have left your company in the last 5 years.	NUM

Customer Satisfaction		
Customer complaint ratio	Every economic activity can encounter failure. When selling products or services, it is not rare that customer have complaints. This index has to be answered with a percentage representing the cost of warranties regarding the total of sales.	NUM
Warranty costs	When customers complain or return the product they bought, it is often necessary to give a warranty. This index has to be answered with the percentage represented by the warranty costs compared to the total revenue.	NUM
Customer base growth	Usually, each year a company gains new customers. This index has to be answered with a percentage that represents the average increase in the number of customers on a yearly base.	NUM
Delays	Delays can happen in projects and/or for delivering products. This index has to be answered by indicating the percentage of delays encountered.	NUM
Civil Responsibility		
Components recycled	This index has to be answered with yes or no depending on if your company recycles used materials.	Y/N
Energy costs	This index has to be answered by giving the monthly amount on your company's energy bills (electricity, heating,...)	NUM
CO2 Volume	This index has to be answered with yes or no depending on the fact whether or not your company produces CO2.	Y/N

Company Results		
Quick Ratio	The quick ratio (also sometimes called the acid test ratio) measures a business' liquidity. However, many financial planners consider it a tougher measure because it excludes inventories when counting assets. It calculates a business' liquid assets in relation to its liabilities. The higher the ratio is, the higher your business' level of liquidity, which usually corresponds to its financial health. The optimal quick ratio is 1 or higher.	NUM
Sales per employee	This index has to be answered by indicating an approximate number of sales realized by an employee in a year.	NUM
Number of stocks	To be able to deliver rapidly their customers, most of the companies have stocks of primary goods, spare pieces or products ready to ship. This index has to be answered by indicating the percentage of stocks compared to the total revenue.	NUM
After sales profit	This index has to be answered by indicating a percentage representing profit compared to the total revenue.	NUM

Table 2 : List of the indexes used in the project

In the first part of the study, companies had to try out the service and answer the proposed indexes. After this step was completed, some remarks could already be given about the quality concerning the choice of indexes.

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When looking at the number of users who answered each indicator on the web site, we can see that the average answer rate for the index listed below is a little more than 89%. So we can say that most of them were neither too difficult to give an answer to nor asked for information that was really unavailable. However, some of them were a little less successful. The Quick Ratio index for instance, with an answer rate of 77.8%, was the one that obtained the poorest results. An obvious conclusion could be that the persons in charge of answering were not familiar with that accounting ratio, or maybe did not have the time or the desire to calculate it. Three other indicators that had less success were the ones talking about sales per employee, improvements and achieved goals. This could be because the given explanation on how to answer the question was insufficient or incomplete. Nevertheless, with an average of 80% and 84.4% of users providing an answer it is still not bad.

On the other hand, there was an indicator that had a very big success. It achieved to get an almost perfect score of 97.8% of users answering it, maybe because it was the first on the list. Another possible reason could be that the users answered it to see how the service was working and to test how long it would take them to answer to the whole study.

Indicator	Answers	Perc.
Quick Ratio	35	77.78
Sales per employee	36	80.00
Customer complaint ratio	41	91.11
Warranty Costs	40	88.89
Components recycled	42	93.33
Customer base growth	41	91.11
Energy Cost	41	91.11
CO2 Volume	41	91.11
IT system Cost	41	91.11
Employee Absenteeism	39	86.67
Training Expenditure	42	93.33
Guiding principles for management	44	97.78
Written Strategy	42	93.33
ISO 9000	41	91.11

Improvements	36	80.00
Training time for new employees	41	91.11
Training time for existing employees	41	91.11
Rewards for high performance	39	86.67
Employee well being practices	40	88.89
Control of management systems	40	88.89
Marketing expenditure	41	91.11
New employees	40	88.89
Leaving employees	39	86.67
Number of employees per project	41	91.11
Number of stocks	40	88.89
Achieved goals	38	84.44
After sales profit ratio	39	86.67
Delays	41	91.11
Totals	40.07	89.05

Table 4 : Most frequently questions answered

Despite its success, there is one index that after all does not seem to have its place in this study. Because it was targeted to companies working in the computer field, the indicator talking about the CO² emissions does not really belong here. It would fit in best in a study on companies working in the industrial field. Even with an answer rate of more than 91%, the experiment of testing the concern of the companies about that subject was a total failure, because all of them answered “no” to the question : Do you produce CO²?

4.3. Study Appreciation

Before giving a in depth analysis of the whole benchmarking and appreciation study, there are a few facts I’d like to point out concerning the participation level of the invited companies. When you start working on a project that calls for the participation of a

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panel of people or organizations, it is said that you can count on about 20 and 80 percent of responses to your request. This shows exactly how difficult it is to make a third party participate in your work.

The study started out by choosing 96 companies that answered to previously determined criterion. At first they were all sent a letter inviting them to participate in the study. Noticing that the response rate was not very high, the decision was taken to give them a little phone call to check on their willingness to participate. This turned out to be very interesting. By talking to various people in various companies, their answers to my request provided useful information, not specifically on benchmarking, but rather on the primary purpose of the whole study. Indeed, as the goal was to discover the interest of companies in a service that would provide them with information that could help or improve their management strategies, their sometimes very colorful reaction enabled me to come to some interesting conclusions.

	Nbr	Perc.
Invited Companies	96	100.00
Companies contacted by phone	52	54.17
Companies who registered	46	47.92
Companies who answered to the benchmarking	45	46.88
Companies who answered to the survey	14	*30.45
Companies who refused to answer	13	13.54

*percentage calculated with the number of registered companies

Table 4 : Participation Level

Looking at the numbers above, we can see that out of 96 companies invited to take part in the study, 46 registered to the service and 45 answered to the benchmarking part of the study. What is important to note is that after sending the letter, only nine answered during the following month. Taking two whole days for calling up the other 85 companies, only 52 were could be reached. In making those 52 phone calls, I gathered a

lot of information on the willingness of those companies to discover and practice new management techniques through benchmarking. Having given to all of them more or less the same speech about the purpose of the project and its use, here is a summary of the responses I received.

The most interesting parts of those answers were the negative ones. Thirteen companies out of 52 gave me with various reasons why they did not wish to participate in the study. The most common one was that they didn't have time. It is quite an understandable answer given the fact that the period of the study, i.e. December 2002 – January 2003, is the busiest one for most of them. They have to finish up the previous year accounting and prepare the budgets while at the same time taking care of current affairs. Giving them the benefice of the doubt, this answer was accepted. It might be important to point out the fact that most of the people giving this answer seemed in fact interested and even sometimes asked for a delay.

Putting aside other classic answers like : "I am not interested in the subject of the study" or "We never answer studies", there were also some responses that caught my attention. For example three companies that were interested in the study and ready to answer to the questions, but did not want to give out any information without an official letter from the University of Fribourg. The fact that in the letter they were sent it was specified that the project was an official study for a degree project was not enough, though. There was another case where someone almost accused me of trying to collect information in order to sell it. He discovered that the domain name of the website was not registered to the university. However the most colorful response I received was that answering to the study would induce investing money in Internet connection time.

To conclude this part of the report, it has to be noted that out of the 96 companies invited, 46 took part in the study. This number is more or less the one hoped to be obtained. The initial goal was 50, but considering the work that took to contact those organizations, I should be happy with 46. This represents a little less than 48%, which is very good considering that the response rate is between 20 and 80%.

A couple more conclusions can be drawn when looking at the participation statistics. As shown in the table above, it is interesting to note that out of 45 companies who registered and participated in the benchmarking part of the project, only about 31% took a little more time to answer the appreciation questions.

Other basic conclusions can be drawn when observing the three tables shown below. They all give us a good image on the number of companies who registered when classifying them by sectors, sizes and languages. For example, we can see that even if the opportunity was given to register and use the website in English, no one seems to have needed that feature. Similarly, we can notice that most registered companies (more than 80%) have 15 or less employees.

Sector	Nbr	Perc.
Computer network installation	6	13.04
Computer knowledge teaching	6	13.04
IT Consulting	8	17.39
Hardware/software selling	7	15.22
Software development	11	23.91
Electronics	5	10.87
Telecommunication	3	6.52
		100.00

Table 5 : Participation by sector

Sizes	Nbr	Perc.
From 1 to 15 employees	37	80.43
From 16 to 250 employees	9	19.57
		100.00

Table 6 : Participation by sizes

Languages	Nbr	Perc.
French	39	84.78
German	7	15.22
English	0	0.00
		100.00

Table 7 : Participation by language

4.3.1. General conclusions on the Benchmarking part of the Project

As the objective of the study was to test if companies would be interested in an online benchmarking technique, this section of the report will not go into details about the answers given to the indexes by the companies. It concentrates on providing general conclusions that could be related to the testing of the regional market. Not all the indexes will be described, but focus will be put on the ones that may be of interest.

Looking at the calculated averages, which are based on the answers given by the various companies depending on their field of activity, the first thing we see is that the numbers vary from each other and sometimes do not even come close. Let us take a closer look at the results obtained by the index about the average number of new employees hired each year. This indicator is quite representative because it has been answered by almost 90% of all registered companies, a little more than average. The first observation we make is that the average fluctuates from less than one to more than three persons. Some sectors seem to hire less than others.

For example, a shop which sells hardware and software products may be less in need of new employees, because the ones who answered are stores owned and run by the same persons. Their expansion not necessarily raised the question of investments in new staff. On the other hand, the need for new specific software and training of users may have allowed companies working in those fields to enlarge theirs. Nowadays we see and hear more and more advertisements for computer classes targeted to people wanting to catch up with this new way of working. Similarly, organizations want to work with their data in an environment which precisely fits their activity and needs, thus needing computer consulting and others to develop software specifically for them.

New employees	Max	Avg	Min	Num
Computer network inst.	3	1.75	1	4
Computer knowledge teaching	5	2.5	1	6
IT Consulting	2	1	0	7
Hardware/software selling	1	0.83	0	6
Software development	20	3.35	0	10
Electronics	3	1.75	1	4
Telecommunication	3	2	1	3

Table 8 : Results of the index “New employees” by sectors

Even if the results gathered for the other three sectors are interesting, we ought to compare them with the number of answers. I believe that the under evaluated conclusions we could draw would not be better than a clever guess.

New employees	Max	Avg	Min	Num
1 - 15	5	1.47	0	30
16 - 250	20	3.65	1	10

Table 9 : Results of the index “New employees” by sizes

If we use the same approach as before and look at the table above showing the results for the same index but distinguishing between the different company sizes among the registered ones, it would appear that larger companies tend to hire more personnel than smaller ones. Like before, the explanation could be that small companies are owned and managed by one or two associates who may have a couple of coworkers to help them. If the business does not grow a lot they do not need to have more employees.

As for the previous index, the one about the expenditures for marketing can also be classified as one that gives an interesting snapshot of the regional market. Table 10 shows the obtained results. This time the numbers can be put in two separate categories: below and above an average of 4. It seems that sectors which are directly in contact with the public, like “hardware/software selling”, “computer knowledge teaching”, “electronics” and “telecommunication”, spend more on advertising than the other companies, which work with larger partners.

New employees	Max	Avg	Min	Num
Computer network inst.	5	3.4	2	5
Computer knowledge teaching	5	4.17	3	6
IT Consulting	5	2.64	0.5	7
Hardware/software selling	8	4.5	2	6
Software development	5	3.11	1	9
Electronics	5	4.2	2	5
Telecommunication	5	4	3	3

Table 10 : Results of the index “Marketing Expenditure” by sectors

Again, as the subject of this study was not to give an in depth analysis of the given answers of the benchmarking part, all the tables included in this subchapter are available with the rest of them at the end of this study in annex 3.

When calling up the companies to re-invite them to participate in the study, one of my main arguments was that after having tested the site, I was able to tell them that it should take only about 15 minutes to complete about 75% of the indexes. During those phone calls, I also learned that most of the companies were not willing to take up more than that span of time. Not only did the testing prove to be true, but in fact the global answer rate ended up being a little over 89%. This can have several meanings. They all had the information easily available to them and then just browsed through the questions to insert their answers. However, it seems more likely that they all put down estimations of their actual numbers and that most of them went along with their best guesses. Clues to those interrogations will be given when analyzing the final survey in the next chapters.

4.3.2. Utility of the Benchmarking Process

After having given the registered companies enough time to play around with the online benchmarking service, they were all sent an email proposing them to complete a short survey where they were able to give their opinion on benchmarking and the website. For reference, the complete survey can be found in annex 2 at the end of this report. The benchmarking part had three main aspects: utility of benchmarking, utility of the calculated results and general usefulness of the concept and remarks.

As planned, the survey was not the only source for information about benchmarking. Of course, looking at the general conclusion drawn previously helped to focus the problem. But the fact remains that two phone calls gave me a pretty good picture of the situation. During the first one, my request of participating in the study was initially rudely rejected. Trying to convince my interlocutor, he started explaining to me that in a previous job he had come across benchmarking. The impression it had left him with had not been good one. Underlining his opinion with several examples, he then went on to tell me that he

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would not take part in the study. To summarize his arguments, strangely enough they all had to do with the availability of information. Wanting to learn something from that discussion, I decided at the last minute I to add one more question to the survey about that availability.

The second interesting phone call was to someone who had never even heard of benchmarking. We ended up talking for more than 15 minutes, and he concluded the discussion by telling me that he was looking forward to being able to look at the results calculated by the service.

The goal was to discover if the interviewed companies were answering to the indexes because they had the information on hand or if they had a real interest in the results the service could provide them. After analyzing the results (figure 18), it appeared that most of the companies, almost 62%, did answer because of the availability of information. This could mean that only about 38% had a slight interest in the subject of the study. Maybe the others were just participating out of curiosity. Considering the fact that all the companies answered that they had no problems finding the requested information, either the indexes were too general or the persons who answered had in fact a good knowledge of their company. It would be interesting to find out if the interested companies and the curious ones were satisfied with the service provided.

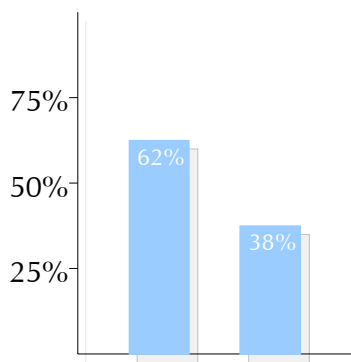


Figure 18 : Results from the survey – Question 2

4.3.3. Utility of the Results

Continuing the analysis of the survey, questions 4 through 7 (annex 2) had the objective to determine if the companies were able to extract results from the indexes and the answers they provided. First of all, the goal was to know if this benchmarking process made them discover new management aspects. With indexes talking about the number of days of absenteeism, employee well-being practices and written strategy, I was hoping that most of them would answer positively to that question. Regarding that choice of indicators, it was a test for the sample companies which were in most cases local and employed less than 16 persons. My doubts were justified because the result show that only one out of the 14 companies who gave their opinion about the service seems to be acquainted with those management aspects.

Because the purpose of the survey was not to ask for every detailed analysis they were able to make, the companies were asked about things they learned from it and things that surprised them. What is interesting is not the number of them who answered with yes or no, but the reasons or examples they were able to provide. For the one about the surprising aspects, the reasons given can all be merged into one. Summarized, it is all about the differences with the other companies. To me it seems that another question should have been added to gather more precise information. The conclusion can be interpreted in different ways. The surprises came from large differences in the numbers and from small ones. That would imply that the benchmarking process worked, because the persons may have wondered about those divergences. If we look back at chapter 2, we can see that this is indeed the basic principle of benchmarking.

The most frequently given answers to the next question (figure 19) can once again be divided into two groups. When looking at what companies have learned when trying out the online service, about 43% of them seem to have seen interesting statistics in the calculated numbers, and another 36% seem to have put their hands on new management criterions. This is all good for the purpose of the study because it shows

that at least they found something worthwhile in benchmarking. It all represents arguments for a future democratization of the practice. Hence, because the main goal of a benchmarking service is to make the companies think about their management and position on the market the ones who participated seem to have been able to get something out of it.

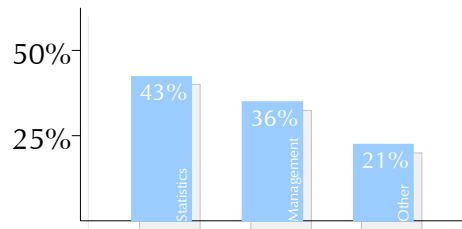


Figure 19 : Results from the survey – Question 6

The 21% left of the given answers include two negative ones. Both express the same feeling that the results were calculated using too few companies. This issue had to be raised. It is true that in some sectors the number of answering persons was maybe a little too small compared with the market or the subject of some indexes. However, unless all the local companies were to be invited and the sectors broadened, the results would have been similar. For those two companies, the results of the indicators were not as satisfying as they could hope, but let us see if they found the concept useful.

The final aspect about the results was to see if the participants were going to use the service more regularly regarding the numbers that were provided to them. In fact, 72% of them had reasons to come back and to analyze the answers again. Not all of them gave reasons for their choice, but the ones who did it was all about management control, and information about the market. Those answers are, in a way, promising for the service because it means that what they want is to be able to see some kind of evolution.

4.3.4. General Usefulness of the Concept and Remarks

The last three questions regarding the service provided general information about the users' opinion of the benchmarking process. For this analysis of the results the goal is to reinforce the information gathered through the participation and to show that the study was successful.

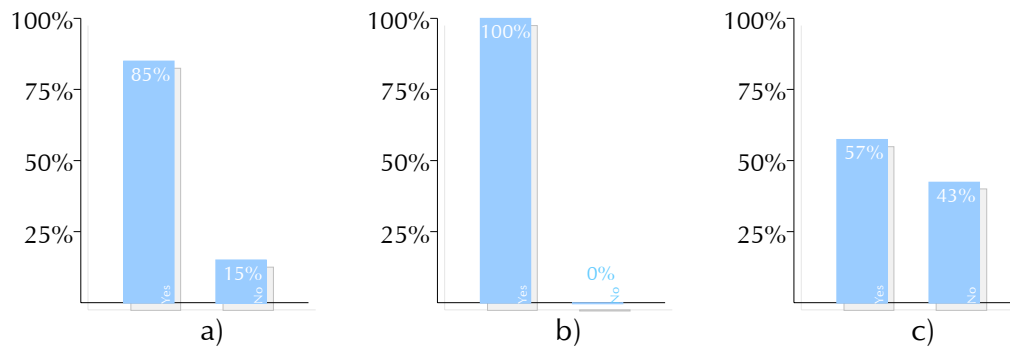


Figure 20 : Results from the survey – Questions 9-11 (a. benchmarking new; b. useful/interesting; c. regular use)

The conclusions presented hereafter have their origin in what was expected when the project was just starting off. At first, the objective was to introduce user-friendly benchmarking techniques to local companies. The survey then showed that as a matter of fact, most companies were unfamiliar with the concept of benchmarking but that they all found something useful or interesting in it. In spite of the general approach of the process, and referring to survey answers previously discussed, it can be said that most companies were able to get something out of it and, who knows, may have come upon a new method of management. But the real interrogation could be : Despite the general interest in the method, is the online service the most suitable way to practice it? With the fear all organizations experience when it comes to providing confidential data, it is a justified question.

Graph c in figure 20 shows that about 57% of the companies who responded to the short survey were interested in using benchmarking more frequently. Weighing this result against the one from the question whether they learned something from it (figure 19), we observe a difference. Whereas almost 80% of them found something interesting in the averages calculated for the various indexes, that number decreases to less than 60% when asked if they would consider using the method more frequently.

There is an even larger gap when comparing these results with the ones from question number 7. The question being the same but regarding the service and not benchmarking, we can conclude that companies see an interest in having such a service, but maybe will not use it as a real benchmarking tool.

4.4. Website Appreciation

Testing the appreciation of a website can be very frustrating for its designer, but in this case the results gathered in the survey will be used to determine the impression the users had when browsing it. That information will help in deciding whether the positive reception of the service was influenced by the presentation of the pages.

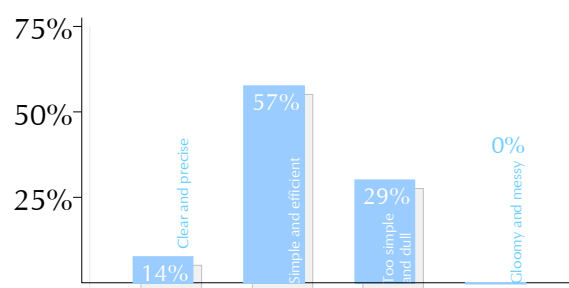


Figure 21 : Results from the survey – Website – Question 1

As shown in figure 21, the general impression of the website was rather positive. For this reason and also because it is rather difficult to elaborate conclusions from the gathered numbers, the results will be presented in their original form and the necessary comments added. Self-critics will also have their place in this subchapter. All the questions from the survey concerning the website will be presented with the exception of question number 5. The answers gathered for this one will be summarized in subchapter 4.5.2..

4.4.1. Quality and Ease of Use of the Interface

In order to try to evaluate the quality and ease of use of the interface, three questions were asked. The first one proposed the client to attribute grades to various aspects of the website. The results gathered are shown in figure 22. On the represented scale, grade 6 is the best and 1 the worst. As you can see, the results are quite satisfying. Compared to those results of question number 1, it appears that this way of grading sensations sums up to a similar result as previously.

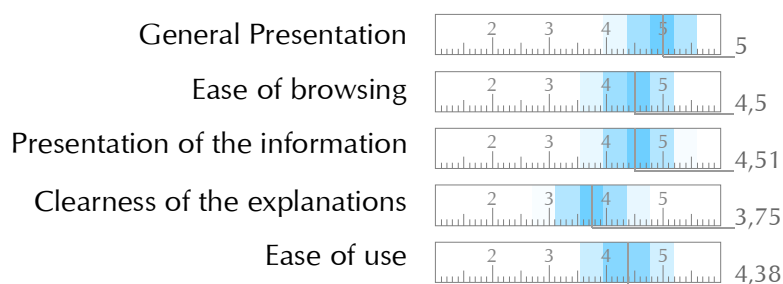


Figure 22 : Results from the survey – Website – Question 2

The best score is achieved by the general presentation of the interface. And the worst one is attributed to the clearness of the explanations. This result can be understood if we look back at the possible reasons why companies did not answer certain indexes. Some indicators were less successful, and we put the fault on the explanations being a little unclear. This survey question emphasizes this possibility.

The other aspects of the website seem to have been enjoyed and appreciated by the majority of the users. Moreover, if we look at the answers given for question number 3, none of them encountered any problem while using the website. Even with the pop-up windows that appear and allow answering the indexes, the clients were neither confused nor disturbed. In general, internet surfers do not like this type of window, but it was maybe after all a nice way to present the indexes without having to reload continuously a large page.

When asked if something surprised them in particular, the answers the users gave were of no particular interest. Out of four answers given, two had to do with the slowness of the website despite the small number of images. This is understandable because the webserver used for the project was not very powerful, the PHP engine and the Mysql database had troubles working at their best. The two other answers referred to the simplicity and the lack of pictures of the interface. Those remarks are not really relevant because such a service is not supposed to present a flashy interface. Illustrations are suitable and recommended when showing the results of the indexes but there is no need of having images in every corner.

4.4.2. Implementation Techniques

Questions about implementation techniques were not included in the survey because they would have been too open and would not have provided clear conclusions. Of course, remarks are always interesting, but in this case I preferred to talk to specialists in the field of web-editing. The relevant remarks I got were about implementation choices for security and the software used.

The critics about the safety of the website were not intended to point out an obvious lack of it but were propositions regarding other aspects of security. Some of the earlier ones were taken into account and added to the latest version of the website. For example, the fact that a company should not be allowed to see the results of an indicator if it has not previously answered it.

When the time came to install the service on an open website, the company which provides the server questioned me about my choice of software. They were not very familiar with the software used, because their main tool is Java. They had the same concerns as myself about moving the website from my local server to theirs. After a couple of days of collaborative work, we finally got everything running smoothly. In the end they were very pleased with the techniques used and their effectiveness for this study.

4.5. Future Enhancements

As the whole study was ending and being put down on paper, new ideas came to mind concerning the next goals that could be aimed for if it was to be continued. A differentiation must be established between what can be classified as the two big aspects of this project. First of all, the objective was to discover the interest of regional companies for benchmarking. Thus enhancements could be discussed for that part of the study. Secondly, the website also has to be worked on when trying to improve the service; it has nothing to do with the technical part, but more with the ease of use and the presentation as a whole.

There are also a couple of improvements which do not fit properly in any of the previous categories. For example, throughout various discussions with friends and companies, there have been remarks on the size of the description which comes with every index. Some comments suggested expanding it while being a little more precise. Other people felt that some indexes maybe gave too much information, thus confusing the reader on. Most of those remarks were useful and some changes were made before opening the website. Unfortunately, some of them came to my knowledge only afterwards and were not used immediately. Nevertheless, in a future version of the study even more thought will be put in describing the indicators to ensure that the answer rate will be even higher

than the average of 89% achieved at this point. A good idea would be to have for each index something like an identification card. It could include data such as a description, guidelines on where to find or how to calculate the answer, an example on how to respond, and maybe a link to complementary information.

Another example is the subject of contacting the companies. As previously presented, the fact that more than half of them were contacted by phone helped me a great deal, but some of them still found excuses not to participate. Of course, companies always have a heavy work load, but I still believe that with the improvement of certain aspects the process could go more smoothly :

- if the study was to be done during another period of the year;
- if more information about benchmarking and its benefits would be at disposal;
- if a larger sample of companies would be selected;
- and if everything would look more official.

This would also implicate higher costs for preparing the document and sending it to the future participants.

4.5.1. From the Benchmarking Aspect

Because the benchmarking part went pretty well, I did not consider any enhancement in the beginning. However after revising the fundamentals of the process and discussing it with other people, a few comments found their way into this report.

In their paper “Process Performance Measurements Systems”, P. Kueng and A. J. W. Krahn write that “in addition to a systematic evaluation of business performance, the other goal of benchmarking is the identification of best practices”. A systematic approach is in fact the one thing missing from this study. In other words, it should have

been done over a much longer period of time during which the companies would have had the opportunity to answer more than once the same indexes. This would have been more beneficial to them because, then they would not only have been able to compare themselves with other companies at any given moment, but also to look for an evolution in their own numbers. They would have got an even better experience with benchmarking and thus they might have been more interested in using it regularly.

For some of the indexes, the organizations had to take several numbers and mix them to get to the answer they had to put in. This problem could be taken care of by doing something that is fairly often used by large companies to check on their partners or branches. They send out forms where the person in charge has to provide basic numbers from the company like total revenue, number of employees, information about their balance sheet, etc... They then compile those numbers and calculate the quick ratio, the sales per employee, etc... This practice is much easier for the person doing the benchmarking because he does not need to take time or energy to calculate anything.

Improvements in the benchmarking part could be achieved by easing up its process. This could be done with the help of more precise indicators, the answers to which would be less time- and effort-consuming to give. With those, the system could calculate even more interesting numbers and then present them to the clients. For example, the user enters the total revenue and the number of employees of his company. The machine would then extrapolate from that data the average sales per employee. Making the service easier to use and with more background processing would help to get an even better participation rate.

Now that all the benchmarking process has been done, it is really comes down to considering the results and weighing them against the present situation and the aimed for goals. There is no magic formula to do this. Deep reflections are needed in order to be able to consider and apply improvements. This part of the process is very important, in order to ensure that the use and application of what has been learned will be a

success. The person in charge takes all the gathered information, draws his conclusions and then figures out a way to apply them to his company. Because there is no magic formula to do this part of the job, the service could provide the users with experiences other companies made in applying changes. From the administrator's point of view, it is not an easy task because he should stay as objective as possible. Thus the fact of simply exchanging experiences is not the best way. The solution could be to extend the survey part of the service to analyze the categories of indexes. The thing would be to take one or two categories which gave problems when trying to analyze its results and to create a form where the companies could explain their troubles. First we would ask for information about the differences observed in the numbers. Then the person in charge could describe his thoughts, and in the end, come up with a possible solution and the hoped for results. That information would then have to be summarized. Once created, this could be some sort of a guideline card, filled with examples, for the analysis of those indexes. The point would be to share various solutions and their applicability without disclosing the names of the companies.

4.5.2. From the Website Aspect

Looking back at the survey, regarding the website, there was one question which was repeatedly put to the users. In their opinion, was there something with the interface that needed to be improved. They could choose between three aspects which were eligible for enhancement. Out of the 14 companies who participated in the survey, the answer the most frequently given was security. The reason for this is obvious. Because the information they are supposed to provide is very personal and confidential, it should not be accessible to others. So in a way the feeling that this aspect of the interface ought to be improved really originates in the fear of losing something. This is quite understandable, but any amelioration to that effect would be invisible to the users. They would just have to rely on promises made. For example, the password used could be encrypted, but the client would still have to type it and thus everything would look the same to him. Moreover, he would still have to trust the designer of the pages.

With the benefit of hindsight on the conclusion made for question 7 of the survey in chapter 4.3.3., an interesting improvement could indeed be added to the website. In the case of multiple occurrences of the study over a given period of time, like let us say every two months during a year, the goal would be to see evolutions in the calculated results. From the website angle, this could be achieved with the already available option of multiple surveys provided by the "SURVEY" table and its link with the result table. The enhancement would be to include code in the pages to generate graphics which would show those curves. For example, there could be a graph presenting not only the evolution of a company's answers over time but also the changes in the calculated average. This would allow the clients to see if they tend to approach or move away from it.

Other improvements that could find their place in a new version of the website may be considered as less important by the public. I am talking esthetic. Small changes could be applied to that effect. While it is not the subject of this report, thoughts could be put in a newer version just to make it look more attractive, thus maybe enhancing the chance of returning-clients.

5. Conclusion

The outcome of this study proved to be quite successful as all the research goals that were decided at its beginning have been achieved successfully. Despite a slow start when questioning the invited companies, the various numbered results and comments gathered allowed to show that there is an interest in benchmarking among small and medium sized companies. The ease of use of the online service helped a lot and seems to have been enjoyed by most of them.

How to improve performance is an issue that concerns every manager in every organization. Performance in this context can mean financial performance – profitability, return on investment or non-financial performance – customer satisfaction, employee satisfaction, and so on. In fact, it is now widely accepted that financial aspects of management are not the only drivers of future financial performance. Easy to use tools like the ones presented above can be a solution for small and medium sized companies who want to act like the big ones. Participating in such a study over a longer period of time could help them to gather information that may prove very useful to their management. Large studies are already taking place in various organizations around the world. Every one of them comes up with a new and improved way to do benchmarking, and new aspects which could be evaluated. While in the beginning they were focusing on large companies, nowadays, they seem to expand their work in order to include the smaller ones. For example, the EFQM Organization is publishing new articles about doing benchmarking and using their excellence model in small and medium sized companies. It seems to be the branch in quality management where there is still work that needs to be done.

For the companies, the hard part was to draw conclusions about what they did and information gathered by the service. Because there is no magic formula, if they did it consciously, it must have been pretty hard. As explained, it is important for them to communicate the results and changes in a clear and meaningful way. But because none

Conclusion

of them are experts in the field the operation is very hard and can be dangerous. It should never be forgotten that the most relevant aspect of the whole process is to think thoroughly about the situation and draw conclusions only if they are of value and applicable to the context. The objective is not to change the world. In this sense, the project did not encourage applying changes, but prompt reflection.

From a technical point of view, despite the hosting problems encountered when publishing the website, everything went very smoothly. The tools used proved to be very powerful and easy to use. Everything that was planned to be included in the project had found its solution. If it was not for compatibility issues, even more options would have been at the users' disposal. Especially the opportunity to print out a complete report paper including the answers given to the indexes, the calculated results and several automatically generated graphics.

When sending out the letters inviting the companies to take part in the study, hopes were very high for the success of the project. But when after a couple of weeks I had only a few participants to show up for, I knew I would have to insist. At the start of the project an idea to raise the participation level had been to visit the companies and to take time to present the project in person. But the solution of using the phone was preferred. It is even recommended in some studies about benchmarking that in order to gather information, talking to the persons in charge on the phone provides more details. The discussion that ensues usually helps to get a better understanding of the problems at stake. This is what happened. The minutes spent on the phone presenting and defending the usefulness of the project contributed to the survey in analyzing the interest the selected companies showed for new management techniques and benchmarking in general. I have to admit that it was all for the best because by calling people I discovered more than by simply looking at the results of the survey. What more is, it allowed me to draw some interesting conclusions and completed, in some way, the ones made previously when analyzing the benchmarking part.

Conclusion

In a certain way, the project presented in this report really fits the momentum of the benchmarking field. Even if the study relied only on a small sample of companies, I believe that interesting conclusions can be drawn and that in some way they lead in the direction of present-day studies. Indeed, the analysis performed shows that the companies were quite pleased having been given the opportunity to evaluate themselves against others. Even if some of them saw it as statistics or information about the market, the fact remains that they found something useful in it and that it has to do with benchmarking.

As hard as it might have proved to find interested participants, the final verdict nonetheless is promising. With a participation rate of more than 45%, the study in itself was a success. There are some points that should have been or need to be improved in the case of a continuation. Those should not be considered mistakes, but as observations resulting from the study. The experiment should be broadened to a larger sample of companies. That could be achieved by expanding the geographical region or by including more sectors. Some time should be given to improve the presentation and description of the indexes. By providing better information, not only the task of answering, but also the analysis of the results could be facilitated. Last but not least, more detailed results could be provided by the system, thus permitting a much more thorough analysis. Example of solutions and their applicability could be provided.

Despite all the numerical results and the conclusions drawn, there are a few things that need to be learned from this study. The main thing is that there is an interest for new management techniques like benchmarking. At first, the fact of comparing oneself to others in search of better performance may seem easy, but after giving the process a try the hard part consists in coming to the right conclusion. Nevertheless, as long as it prompts reflection, the operation is successful. The levels of interest can vary but the approach is always to achieve better results.

The benefit of such an online service consists mainly in easing access to information for the companies, small and medium sized ones in particular. By having them all gather in the same place, a better exchange of data is possible. This provides access to practices which are usually reserved to large companies who do not have problems investing time and money. The only problem is the awareness of the process. People need to be guided in order to make the best out of such a service. It would be dangerous for them to make quick and uninformed decisions.

The lack of magic formula for the analysis of the results can make the person in charge not take action or else take the wrong one. Thus it is very important to give them time to think about the situation. In the case of this study, they were given over two weeks to hand in their opinion on the process.

Another important lesson to be learned from this experience is that the choice of the indexes had a big influence on the outcome of the project. Two decisive aspects were that they had to be easy to comprehend and answer and also offered the possibility to draw applicable conclusions. Without good indexes, the service would not have been of any use. Not only did they talk about familiar management characteristics, but they also allowed for easy understanding of the results.

Considering the learning experience the study provided and also the ideas for future enhancements suggested throughout this report, it can be said that this way of providing a benchmarking service to small and medium sized companies is very promising. With the analysis of the results and the many conversations I had, I tend to believe that even within this type of companies there is an interest and also a need for performance driven management techniques. Benchmarking can be applied to any organization, but what is most often missing is a user-friendly tool that can help with the process. Nowadays, with the ever expanding use of the internet to do business, it seems obvious that this is the path to take. Combining this interest and need for self-evaluation techniques with the large availability of the network and with the right type and amount of background information, the service will proof to be quite successful.

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«**Société**»
«Prénom» «Nom»
«Adresse1»
«Adresse2»
«NPA» «Localité»

Arconciel, le 31/03/2003

«Titre»,

Etant actuellement en train de terminer les cours d'informatique à l'université de Fribourg, j'effectue actuellement mon travail de mémoire chez le professeur Andreas Meier. L'étude que j'effectue traite du Benchmarking des entreprises. Ceci consiste en fait à évaluer les différents processus d'une entreprise et ensuite de les comparer avec ceux obtenus par d'autres.

Dans le cadre de ce travail le but est de développer un site Internet permettant à différentes sociétés de répondre à quelques indices plus ou moins répartis par processus. Dans un deuxième temps il permet à ces mêmes sociétés de comparer leurs propres résultats avec des moyennes par secteurs d'activité et par tailles d'entreprises.

C'est donc avec grand plaisir que je vous invite à venir visiter ce site et à vous y inscrire.

<http://www.corpbench.com>

Dans un premier temps je vous propose de répondre à quelques indices. Par la suite, dès que quelques sociétés ont également répondu, je vous invite à y retourner et à regarder les résultats obtenus. Ensuite je me permettrais de reprendre contact avec vous et de vous proposer de me donner votre avis sur le service en remplissant un bref questionnaire.

Toutes les informations enregistrées par vous ou votre société ne sont accessibles que pour vous. Elles ne seront en aucun cas mises à disposition des autres personnes ou sociétés répondant à cette étude. Les seuls chiffres publiés sont des moyennes représentant des secteurs d'activité ou des tailles d'entreprise.

De plus, lors de la rédaction du rapport final d'étude, aucun nom de personnes ou de sociétés ne sera cité sauf autorisation préalable.

Tout en vous remerciant d'avance, je vous envoie, «Titre», mes meilleures salutations.

Survey

The service

1. How many indexes did you answer to for this study?
 Less then 10 Between 10 and 20 More then 20

2. What argument did you take into account for answering the indexes you selected?
 Interest for the information
 Availability of the information
 Other

3. To answer to the various indexes, did you have easy contact to the needed information?
 Yes No, for the following reasons :
 Information unavailable or not calculated
 Information not updated
 Not willing to give the information
 Without particular reasons

4. Did the proposed indexes talk about aspects that were new to you?
 Yes No

5. When evaluating the results, were you surprised by any answers?
 No Yes, which one(s) and why?
.....

6. Were you able to learn something from the calculated results?
 Yes, example:
 NO, reason:

7. Could you be interested in using such a service more often?
 Yes, Why?
 No, Why?

8. Which aspect of the service should be enhanced?
.....

9. Is corporate benchmarking new to you?
 Yes No

10. Do you think that this process is useful/interesting?
 Yes No

11. Could you be interested in using such a service on a regular basis?
 Yes No

Remarks regarding the service :

The website

1. What is your general impression of the website?

- Clear and precise
- Simple and efficient
- Too simple Dull
- Gloomy and messy

2. Please provide a grade between 1 and 6 for the following aspects:

General presentation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ease of browsing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Presentation of the information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clearness of the explanations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ease of use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Did you encounter problem while using this website?

- No
- Yes, which one(s):

.....

4. Which aspect(s) of the website surprised you in particular?

.....

5. Which option(s) would you like to see added on this website?

- Enhanced security
- Better browsing
- Possibility to print reports from the results
- Others

Thank you again for your participation.

- I would like to receive supplementary information of this study.

Results calculated for the index by categories

Management	Max	Avg	Min	Answer	Perc.
Guiding principles for management					
Computer network inst.		1		5	100
Computer knowledge teaching		1		6	100
IT Consulting		0.75		8	75
Hardware/software selling		0.86		7	86
Software development		0.7		10	70
Electronics		1		5	100
Telecommunication		1		3	100
Control of management systems					
Computer network inst.	12	6.75	4	4	
Computer knowledge teaching	5	3.67	2	6	
IT Consulting	6	3.86	1	7	
Hardware/software selling	24	7.17	2	6	
Software development	40	8.33	0	9	
Electronics	12	5.6	3	5	
Telecommunication	5	3.67	2	3	
Marketing expenditure					
Computer network inst.	5	3.4	2	5	
Computer knowledge teaching	5	4.17	3	6	
IT Consulting	5	2.64	0.5	7	
Hardware/software selling	8	4.5	2	6	
Software development	5	3.11	1	9	
Electronics	5	4.2	2	5	
Telecommunication	5	4	3	3	

Annex 3 – Results calculated for the index by categories

Coworker Orientation	Max	Avg	Min	Answer	Perc.
Training Expenditure					
Computer network inst.	15000	7250	4000	4	
Computer knowledge teaching	4000	1791.	250	6	
IT Consulting	35000	9571.	2000	7	
Hardware/software selling	10000	2542.	0	7	
Software development	5000	3400	1000	10	
Electronics	5000	3900	2500	5	
Telecommunication	8000	5333.	1000	3	
Training time for new employees					
Computer network inst.	45	37.5	30	4	
Computer knowledge teaching	120	31.5	4	6	
IT Consulting	120	37.86	5	7	
Hardware/software selling	120	43.14	7	7	
Software development	90	53.89	5	9	
Electronics	90	43	20	5	
Telecommunication	90	45	15	3	
Training time for existing employees					
Computer network inst.		0.75		4	75
Computer knowledge teaching		0.83		6	83
IT Consulting		0.86		7	86
Hardware/software selling		0.43		7	43
Software development		0.89		9	89
Electronics		0.6		5	60
Telecommunication		0.67		3	67

Annex 3 – Results calculated for the index by categories

Planning	Max	Avg	Min	Answer	Perc.
Written Strategy					
Computer network inst.		1		4	100
Computer knowledge teaching		0.83		6	83
IT Consulting		0.86		7	86
Hardware/software selling		0.57		7	57
Software development		0.6		10	60
Electronics		0.8		5	80
Telecommunication		1		3	100
Number of employees per project					
Computer network inst.	3	2.5	2	4	
Computer knowledge teaching	2	1.33	1	6	
IT Consulting	2	1.64	1	7	
Hardware/software selling	2	1.43	1	7	
Software development	4	2.65	1	10	
Electronics	2	2	2	4	
Telecommunication	2	2	2	3	
Achieved goals					
Computer network inst.	85	40	5	4	
Computer knowledge teaching	75	51.17	20	6	
IT Consulting	90	44.17	30	6	
Hardware/software selling	80	34.29	10	7	
Software development	80	48.25	25	8	
Electronics	75	36.25	20	4	
Telecommunication	25	16.67	10	3	

Annex 3 – Results calculated for the index by categories

Resources	Max	Avg	Min	Answer	Perc.
IT system Cost					
Computer network inst.	16250	8187.	4500	4	
Computer knowledge teaching	40000	21250	5500	6	
IT Consulting	12000	4642.	1000	7	
Hardware/software selling	6500	3974.	320	7	
Software development	10000	5670	1000	10	
Electronics	24000	13500	8000	4	
Telecommunication	6500	4000	1000	3	
New employees					
Computer network inst.	3	1.75	1	4	
Computer knowledge teaching	5	2.5	1	6	
IT Consulting	2	1	0	7	
Hardware/software selling	1	0.83	0	6	
Software development	20	3.35	0	10	
Electronics	3	1.75	1	4	
Telecommunication	3	2	1	3	

Annex 3 – Results calculated for the index by categories

Quality Systems	Max	Avg	Min	Answer	Perc.
ISO 9000					
Computer network inst.		0.75		4	75
Computer knowledge teaching		0		6	0
IT Consulting		0		7	0
Hardware/software selling		0.17		6	17
Software development		0.18		11	18
Electronics		0.5		4	50
Telecommunication		0.33		3	33
Improvements					
Computer network inst.	25	14	2	3	
Computer knowledge teaching	10	5.17	0	6	
IT Consulting	8	4.33	2	6	
Hardware/software selling	80	17.29	0	7	
Software development	12	5.38	3	8	
Electronics	15	10.75	6	4	
Telecommunication	20	16	12	2	
Rewards for high performance					
Computer network inst.		0.25		4	25
Computer knowledge teaching		0		6	0
IT Consulting		0.86		7	86
Hardware/software selling		1		7	100
Software development		0.75		8	75
Electronics		0		4	0
Telecommunication		0.67		3	67

Annex 3 – Results calculated for the index by categories

Coworkers satisfaction	Max	Avg	Min	Answer	Perc.
Employee Absenteeism					
Computer network inst.	5	3.75	2	4	
Computer knowledge teaching	1	0.17	0	6	
IT Consulting	12	3.29	0	7	
Hardware/software selling	4	2.67	0	6	
Software development	3	1.75	0	8	
Electronics	10	5.4	3	5	
Telecommunication	5	3.33	2	3	
Employee well being practices					
Computer network inst.		0		4	0
Computer knowledge teaching		1		6	100
IT Consulting		1		7	100
Hardware/software selling		0.71		7	71
Software development		1		8	100
Electronics		0.6		5	60
Telecommunication		0.67		3	67
Leaving employees					
Computer network inst.	8	4	1	4	
Computer knowledge teaching	4	2.17	1	6	
IT Consulting	4	1.43	0	7	
Hardware/software selling	6	2.67	0	6	
Software development	10	3.62	0	8	
Electronics	5	3.2	0	5	
Telecommunication	3	1.67	1	3	

Annex 3 – Results calculated for the index by categories

Costumer satisfaction	Max	Avg	Min	Answer	Perc.
Customer complaint ratio					
Computer network inst.	7.5	4.88	3	4	
Computer knowledge teaching	10	5.67	1	6	
IT Consulting	3	1.71	0	7	
Hardware/software selling	5	2.5	0.5	7	
Software development	4	2	1	9	
Electronics	5	4.2	2	5	
Telecommunication	4	2.67	1	3	
Warranty Costs					
Computer network inst.	8.5	5.88	4	4	
Computer knowledge teaching	1	0.33	0	6	
IT Consulting	12	3.57	1	7	
Hardware/software selling	3	1.79	0.5	7	
Software development	10	3.33	0	9	
Electronics	5	3.25	2	4	
Telecommunication	5	3	1	3	
Customer base growth					
Computer network inst.	13	9.38	4	4	
Computer knowledge teaching	18	12.67	5	6	
IT Consulting	15	8.57	5	7	
Hardware/software selling	120	25.71	5	7	
Software development	25	11.33	1	9	
Electronics	17	12.2	10	5	
Telecommunication	50	22	8	3	
Delays					
Computer network inst.	13	6.5	1	4	
Computer knowledge teaching	20	5.33	0	6	
IT Consulting	10	4.14	0	7	
Hardware/software selling	9	3.67	1	6	
Software development	20	9	5	10	
Electronics	10	7	1	5	
Telecommunication	10	6.67	4	3	

Annex 3 – Results calculated for the index by categories

Civil Responsibility	Max	Avg	Min	Answer	Perc.
Components recycled					
Computer network inst.		1		5	100
Computer knowledge teaching		1		6	100
IT Consulting		1		7	100
Hardware/software selling		1		7	100
Software development		0.8		10	80
Electronics		0.5		4	50
Telecommunication		0.67		3	67
Energy Cost					
Computer network inst.	2500	1787.	1000	4	
Computer knowledge teaching	3000	1700	700	6	
IT Consulting	2500	1028.	100	7	
Hardware/software selling	8000	2267.	220	7	
Software development	7000	2195	150	10	
Electronics	3250	2662.	1800	4	
Telecommunication	1800	1090	120	3	
CO2 Volume					
Computer network inst.		0		4	0
Computer knowledge teaching		0		6	0
IT Consulting		0		7	0
Hardware/software selling		0		7	0
Software development		0		10	0
Electronics		0		4	0
Telecommunication		0		3	0

Annex 3 – Results calculated for the index by categories

Company results	Max	Avg	Min	Answer	Perc.
Quick Ratio					
Computer network inst.	3	1.83	1.2	3	
Computer knowledge teaching	4	1.45	0	6	
IT Consulting	3	1.42	0.9	5	
Hardware/software selling	3	1.43	0.8	6	
Software development	250	33.78	0.8	8	
Electronics	15	4.56	1.1	5	
Telecommunication	1.2	1.15	1.1	2	
Sales per employee					
Computer network inst.	250000	166000	98000	3	
Computer knowledge teaching	100000	43500	2500	5	
IT Consulting	250000	14166	40000	6	
Hardware/software selling	500000	225000	150000	6	
Software development	200000	15944	120000	9	
Electronics	260000	161250	75000	4	
Telecommunication	10000	530000	210000	3	
Number of stocks					
Computer network inst.	6	4.25	2	4	
Computer knowledge teaching	2	0.8	0	5	
IT Consulting	3	0.71	0	7	
Hardware/software selling	12.5	6.5	3	7	
Software development	100	10.9	0	10	
Electronics	7	5.5	4	4	
Telecommunication	4	3.33	3	3	
After sales profit ratio					
Computer network inst.	15	9.5	6	4	
Computer knowledge teaching	12	6.33	0	6	
IT Consulting	50	16	-0.01	7	
Hardware/software selling	9	7.2	5	5	
Software development	20	9.11	3	9	
Electronics	12.5	8.5	4	5	
Telecommunication	8	6.33	3	3	

Thanks

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