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Statistical Auditing and the AOQL-method

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Chapter 3

A Practical Case

3.1 Introduction

The Department of Examservices (ED) of the Informatie Beheer Groep (IB-Groep) at Groningen in the Netherlands provides a large range of services to students. The public critically monitors the IB-Groep, because in the past they had some organisational problems, due to too optimistic governmental policy, that led to a poor quality of services to her customers. In this period the IB-Groep became a scapegoat of the public. Recently the quality of services really has improved and the IB-Groep is trying hard to retain and even to improve upon this quality. Because of the past, the IB-Groep lies under the magnifying glass of the public. Thus, quality is very important to the IB-Groep.

One of the many tasks of the IB-Groep is the organisation of public exams. These tasks are carried out by ED. This chapter designs a quality control procedure for some of the administrative processes of ED. This research covers the years 1999 through 2001. Why did the manager of ED commission this research?

- The first reason was a reorganisation (Hero). Due to Hero the audit department had to hand over her control tasks for ED to the employees of ED.
- The second reason had to do with the disappearance of the annual check by the accountants of the Ministry of Education (AD, abbreviation of the dutch term 'Accountants Dienst'). AD does not report about the performance of ED separately any more, but reports over a much broader sector.

ED is just a small part of this sector. The AD will suffice with just a global check instead of the more thorough check that AD used to do. For a more detailed description of this check see Talens (1998).

- The third reason, the most important one according to ED, was the increased awareness of quality thinking caused by the quality charter, market thinking, and responsibility at employee level.

By implementing new better quality control procedures, ED decreases the control risk considerably. This risk is very large at the moment, because with the exception of a superficial check by coworkers no quality control measures are taken.

The check AD used to do was mainly focused on financial errors. The new procedure should, in light of quality thinking, also check on non-financial aspects. Another problem related to the check AD used to do, was that too much time expired before executed activities were inspected. This time interval usually took more than three months. If this time could be shortened, problems would be noticed and dealt with earlier.

Current developments

This subsection sketches some recent developments at the the IB-Groep after this research took place. The organisation of the IB-Groep is always under pressure, and with every new executive changes are made in the organisation to comply with the ideas of the new executive. The new executive introduced a new management model that should increase the capacity. The departments in their current shape are reorganised to become 'production' departments (again). Within these departments there is no place for specialists and the specialised tasks for all production departments are to be performed by a special department (bedrijfsbureau). Notice that this is an opposite course from the course that was brought into action by Hero and one of the reasons why the manager of ED did commission this research is no longer valid. Also auditors are placed within this department and are no longer part of the new production departments and most control tasks are to be performed by this department too.

Other courses of action are taken within the IB-Groep to improve the quality of their services. The IB-Groep has started using the the INK (Instituut Neder-

landse Kwaliteit)-management model. The INK is a corporation to improve the quality of management with the use of the INK-management model. This model is used by hundreds of companies, organisations and government institutions. The INK was founded in 1991 on the initiative of the Ministry of Economic Affairs. Also the OS (onderwijs-service)-department of the IB-Groep are trying to get ISO (International Standardisation Organization)-certification. The ISO-norms consist of a set of international criteria that provide a thought-out structure of an organisation. This enables the organisation to provide a certain wished quality. An organisation becomes ISO-certificated after an inspection by an independent party shows that the organisation complies with the ISO-criteria.

3.2 The COSO Report

The report Internal Control-Integrated Framework of the Committee of Sponsoring Organizations of the Treadway Commission (COSO-report) appeared in 1992. This report provides guidelines for setting up and judging internal control systems. According to the COSO-report internal control is a process executed by a supervisory organisation, management or remaining personnel which is designed to acquire reasonable certainty to what extent the following objectives are achieved:

- efficiency and effectiveness of company processes;
- reliability of the financial reporting;
- compliance of legislation and other rules.

Especially the third part plays an important role in setting up and judging internal control systems in our research at the IB-Groep. Also in accordance with the COSO-report each internal control system can be divided into five components

- monitoring;
- information and communication;
- control activities;
- risk assessment;

- control environment.

To maintain the quality of an internal control system it should be constantly monitored by its supervisors. Changes in the process could mean that some procedures are redundant or other procedures are necessary. The first two reasons in Section 3.1 that gave rise to this research, are a clear example of this. The quality of information should be high, otherwise decisions based on this information could be wrong, and communication should be effective. The control activities are those activities that affect the administrative organisation and the internal control measures that have been taken to reach the objectives set by management. In our research this part plays a very important role. Risk assessment means that management tries to find and analyse internal and external risks that could jeopardize reaching the objectives set by management. The control environment is determined by the attitude of personnel, especially management, towards the risk control systems. The third reason that gave rise to this research (see Section 3.1) is due to a change in this environment.

3.3 Exam Services

The exams ED organises are divided over five different clusters. Each of these clusters organises one exam or several exams. These clusters carry out many processes. Some of these processes are the same for every exam (e.g. travel declarations) other processes are restricted to one exam or a group of exams. An example of the latter was the second correction of school and state exams. Originally this research would develop a new control procedure for the process of checking travel declarations at the SPD-exam. The SPD-exam is an exam for people in the administrative sector. People concerned with the organisation of exams (members of exam committees, correctors, or employees of ED) fill in these travel declarations. ED inspects them and if they are correct, then the amount declared will be paid. Inevitably, errors are made while inspecting these travel declarations. As long as not too many errors are made, this is not considered to be a problem. ED demands that a certain level of errors in the population is not exceeded and a certain quality of the population is maintained. Noticing and correcting errors at an early stage certainly helps maintaining this quality.

3.4 Requirements and solution

The manager of ED had good reasons to implement new quality control procedures. Consultation with the ED-employees led to the following requirements for quality control procedures.

- Due to Hero control tasks should largely be carried out by the ED-employees themselves instead of specialized auditors.
- Normal procedures do not account for correcting errors during the checking time. ED would like a procedure that does account for correcting errors during the checking time.
- If errors are made, ED wants to find the cause of these errors quickly. When this cause has been found, ED can remove this cause and prevent new errors.
- ED would like a procedure that checks on non-financial errors as well, such as time expired before certain processes are finished.
- The number of errors made in a process is not allowed to exceed a certain level defined by management.

A procedure that satisfies these requirements is the AOQL (Average Outgoing Quality Level)-procedure or the revised version of AOQL: EOQL (Expected Outgoing Quality Limit). For a more detailed and technical description of the AOQL/EOQL-procedure see Chapter 6. The difference between the two methods is of a technical nature. The sample design does not differ between the two methods (only sample sizes differ). A short description of the design for the AOQL/EOQL-procedure is given below.

- First management defines the population of the items under investigation (e.g. all travel declarations throughout a year).
- Management defines what is considered to be an error in a process. For instance, for a travel declaration a list of rules can be made this declaration has to satisfy. If at least one of the rules is not satisfied, the declaration is in error.

- Management also defines the number of errors allowed in the population after inspection. Usually management provides a proportion of items allowed to be in error. This limit is called the Average Outgoing Quality Limit and will be denoted by P_l .
- The population has to be divided into a number of subpopulations (e.g. all travel declarations throughout a month or a week) in a sensible way. There are both statistical as well as efficiency reasons not to choose the number of subpopulations too small. Natural divisions of the population into subpopulations are preferred (e.g. monthly reports). It is also wise to separate periods that are likely to contain more errors (e.g. periods with lots of temporary workers) from other periods.
- From every subpopulation a random sample of size n is taken. Chapter 6 describes how sample size and the number of errors allowed in the sample, k_0 , are found. If this number of errors in the sample is exceeded, the subpopulation has to be checked integrally.
- All errors, that are detected during the sampling and during possible integral checks, have to be corrected. Flawless inspections are assumed.

3.5 General considerations implementing AOQL

This section gives an outline of the environment in which the AOQL-procedure has to be implemented. In this sketch three different aspects are considered: technical considerations, philosophical considerations, and organisational considerations.

3.5.1 Practical considerations

Employees are very busy during exam moments, therefore additional manpower is needed to execute the control tasks as well. If ED would decide not to check during the exam moments, the cause of the errors would remain unnoticed. These errors would continuously be made in the process, which causes a lot of corrections afterwards (many subpopulations would have to be integrally corrected). Otherwise this problem would not arise, because ED could remove the

cause of the errors in time. For processes that are similar in different clusters a solution could be to combine these processes in one AOQL-procedure, because the exams in different clusters are organised on different dates. Thus, if one cluster is very busy another cluster has capacity to do the inspection activities. It is important to let grow a feeling of joined responsibility for the activities of each other. Criticism should be dealt with in a positive manner and should lead to an improvement of the quality. One has to be very careful that severe arguments between clusters will not arise, causing a bad working environment.

The employees of ED will check their own activities, that is the activities of their direct colleagues. Within the frame work of separating production activities and control activities, it is important that an employee does not inspect his or her own production work and it is also important to inspect the control activities of the employees in order to prevent cheating. An employee of ED especially concerned with control tasks within ED could do this. To maintain the quality of the quality control tasks these tasks should not always be performed by one single person, but these tasks should be done by various employees. This monitoring of the control activities is also in line with the COSO-report.

3.5.2 Philosophical consideration

As pointed out in the introduction, inspection of the processes was completely focused on financial errors. Thinking in financial terms has become a way of life at ED. They are very persistent in this way of thinking. For instance, when management had to set an error norm for travel declarations they came with the following norm: *the total error amount should not exceed 1% of the total amount*. Statements like *only in error if error > € 50,-* could be found in the error definition made by management. Defining an error in this way would lead to an underestimation of the total error amount if many little (< € 50,-) errors would occur. Moreover, defining the norm as a percentage of items in error of the total amount of items would be more sensible. In this way also non-financial aspects can be taken into account. If overall quality improves, this will lead to a lower unjust amount in the population. This will appear in the global checks of the AD. If AD is convinced that a good quality control procedure is used, AD will inspect less strict and conclude that the financial statements are presented

fairly.

3.5.3 Organisational considerations

At ED a group of employees is democratically chosen to decide on policy matters within ED. This group is called the *steering committee* (BG). The manager of ED should be present at meetings of the BG and they have weekly meetings.

Originally this research would develop a new control procedure for travel declarations for the SPD-exam. This process should be a pilot for other processes at ED. If this would work according to the wishes of ED, other processes of ED would follow. For the department concerned with the organisation of the SPD-exam had just undergone a reorganisation, the BG decided to take the process of second corrections at school- and state exams as the pilot. The following meeting they decided not to, because the next exam moment would be in August. This would give personnel problems, because many employees did plan their holiday in this month. Therefore, they did not have the capacity for the extra inspection activities. Again a week later they finally decided to have the pilot at SPD-enrolments. The BG can be criticised for not being very decisive. Because employees of the clusters are in the BG, they probably hesitated to have the pilot at their own cluster, because the pilot required extra work. Moreover, at the meetings where the pilot was on the agenda the manager was not present to make a final decision. Finally an employee of the SPD cluster agreed to have the pilot at a process of her cluster. Unfortunately SPD-enrolment is a process with pure non-financial aspects. It would have been more interesting to have a pilot with combined financial and non-financial aspects. Of course the relative simplicity of the process could be the reason why the employee of SPD agreed to have the pilot, because not many errors are expected and not much extra work is expected by having to perform inspections of the entire subpopulation. Nonetheless implementing the AOQL-procedure and performing the control activities accompanied with this procedure still demands an additional effort of the employees and therefore it is commendable that they agreed to have the pilot.

The above example shows that an effective communication between management and personnel was not present in this case and although the increased awareness of quality thinking was one of the incentives for this research the

attitude towards the internal control procedures is somewhat hesitant and the control environment can be improved. The effectiveness of communication and the hesitant attitude towards internal control need improvement because they are components on which an internal control system is judged according to the COSO-report.

3.6 The first pilot

The pilot took place at SPD-enrolment. People who would like to do the SPD-exam have to enrol. On the enrolment form they have to fill out some characteristics about themselves. Employees of the SPD-cluster put these data into the computer. We use an improvement of the original AOQL-method, the aforementioned EOQL-procedure to inspect this process. This is not a very complicated process, and beforehand not many errors are expected. So the main reason for doing this process with the EOQL procedure is to gain experience about EOQL in practise and make employees familiar with EOQL.

3.6.1 Sample scheme

The population consists of all enrolments that are processed in March, 2000. Subpopulations are defined as the enrolments processed per day, unless the total amount of enrolments is under 100, then subsequent days are combined until the number of enrolments exceed 100. An enrolment is wrong if:

- the time needed to process the enrolment exceeds three weeks,
- the exam subjects are put wrongly into the computer (code 4).

If a mistake is made in the other characteristics the enrolment is not in error, but these errors will be kept in a database as experience data. These errors are coded in accordance with the questions on the SPD-enrolment form, see Table 3.1. Management has set a norm of 1% of the total amount of enrolments that may be in error. The EOQL procedure should be carried out with the following instructions:

- Determine the number of enrolments in a subpopulation.

Table 3.1. Definition of the error codes at SPD-enrolment.

Code	Error made in:	Code	Error made in:
1a	surname	2a	address
1b	name	2b	mailing address
1c	gender		
1d	date of birth	3a	place of exam (Netherlands)
1e	place of birth	3b	place of exam (foreign country)
1f	native country		
1g	phone number by day		
1h	giro or bank account		
1i	current college	4	subjects
1j	enroled as: student/extraneus		
1k	did a previous exam	5	special circumstances
1l	date + signature		

- Set the number of errors allowed in the sample. This is zero if the previous subpopulation was not integrally checked, otherwise this is one. The starting value is zero.
- If the number of errors allowed in the sample is zero, then the sample size equals 37. Otherwise determine the sample size from Table 3.2, taken from Simons, Van Batenburg and Kriens (1989).
- Take a random sample, check the enrolments and if the number of errors allowed is exceeded, check the subpopulation integrally. Correct all errors!

The sample sizes used in this first pilot were found using the EOQL-method in which a Poisson approximation is used for the underlying hypergeometric distribution, see Simons et al. (1989).

Simons et al. also show that the optimal sample size if the number of allowed errors in the sample is equal to zero, using this procedure, equals e^{-1}/P_l (so with $P_l = 0.01$ this becomes 37). Notice that this does not depend on the population size. The sample sizes we use if the number of errors allowed in the sample equals one also originate from Simons et al., see Table 3.2.

Table 3.2. Sample size (n) for a given subpopulation size and number of errors allowed $k_0 = 1$ for $P_l = 1\%$.

Population size	Sample size
> 100 and ≤ 150	70
> 150 and ≤ 200	73
> 200 and ≤ 250	75
> 250 and ≤ 300	76
> 300 and ≤ 400	78

Table 3.3. Results of the first pilot with the EOQL-method at SPD-enrolment.

no.	subpopulation size (N_s)	sample size (n)	errors in criteria	other errors
1	97	37	0	1b
2	380	37	0	1g
3	123	37	0	1b
4	132	37	0	1a, 1g, 1h
5	132	37	0	1b, 1e
6	171	37	0	none
7	294	37	0	1a, 1e, 1f(2), 1g
8	133	37	0	1a, 1b, 1e, 1g, 1h, 2a
9	93	37	0	1b, 1c, 1g, 1i, 2a
10	594	37	0	1b, 1e, 1h
11	191	37	0	1b, 1c(6), 1g(3), 2a
12	549	37	0	1b(2), 1e, 1g(3)
13	110	37	0	1b(2), 1g(2), 1h

If the previous subpopulation has to be checked entirely, the number of errors allowed in the sample from the subpopulation under inspection is equal to one instead of zero. This strategy is also described in Simons et al. and by doing so the assumption is made that the total amount of work will be reduced. A more detailed discussion about the choice of the number of errors allowed in the sample can be found in Chapter 6.

A computer program has been written by the author to help the SPD-employee with this procedure, see Figure 3.1.

3.6.2 Results

The results of the first pilot can be found in Table 3.3 and Table 3.4. In thirteen different subpopulations the number of errors allowed in the sample was never exceeded; no integral inspection of any subpopulation took place. The conclusion could be drawn that the process of SPD-enrolment is executed in a very precise way.

Table 3.4. Totals of the errors not concerning the main criteria.

Type	Total	Type	Total	Type	Total
1a	4	1g	14	2a	3
1b	11	1h	4	2b	0
1c	8	1i	1	3a	0
1d	0	1j	0	3b	0
1e	5	1k	0	5	0
1f	2	1l	0		

3.6.3 Evaluation

SPD-employees involved with the EOQL-procedure commented on the amount of time the quality control tasks took them. Especially during busy times the quality control tasks would sometimes be neglected. Of course this is not a problem which is specific for the EOQL-method. Any other quality control procedure will give the same problem. The exams ED organise take place at certain dates and activities are concentrated around these dates. Therefore, employees

Invoeren steekproef

AOQL procedure voor Examen-diensten

deelpopulatenummer:

steekproefnummer: van

itemnummer:

Opmerkingen:

Invoeren

Terug

Invoerformulier

Fouten m.b.t. de criteria

SPD-aanmelding

- 1: hoge school waar nu een opleiding wordt gevolgd
- 1j: inschrijving als student/ extraneus
- 3b: examenplaats Buitenland
- 4: fout vakken

Figure 3.1. Screen shot of the input of the sampled SPD-enrolments in the computer program used in the second pilot.

are very busy during exam moments. The following solutions could help to solve the problems of lack of time to carry out the quality control tasks.

- Postpone the quality control tasks until after the busy times connected with the exam moments, but in such a way that the process has been inspected and improved before the next exam moment. This has the disadvantage of not noticing causes of errors during the process. It will cost more time and money to inspect and improve afterwards. Inspections afterwards can also be to the disadvantage and cause damage to customers of ED.
- Hiring extra temporary personnel during the exam period. Except for this being an expensive solution, this will probably also lead to more errors. Unskilled employees are more likely to make more mistakes, because they lack the experience.
- If processes between different clusters largely coincide, then the control tasks can be spread among the different clusters. Very often exam moments are on different dates for the different clusters.
- If processes between different clusters do not coincide, then the control tasks could still be spread among the different clusters. This has the disadvantage that employees have to get acquainted with new processes. But there are also some advantages. During other busy periods employees from less busy clusters can assist the busy clusters and it increases the collective consciousness of the employees.

3.7 The second pilot

After the first pilot ED decided to have another pilot at SPD-enrolment to acquaint more employees with the EOQL-procedure and to become more familiar with this procedure. They changed the error definition and P_l was set at 3%. An enrolment was considered to be in error if a mistake was made in the processing of

- the current college (code 1i),
- the enrolment as student or extraneous (code 1j),
- place of exam (code 3b),

- the exam subjects (code 4).

Due to organisational problems the inspection was conducted some time after the actual enrolment. Although we regretted the delay of the inspection we still thought it would provide valuable information about the process.

In the previous pilot forms were randomly chosen, by just picking the correct number of forms from the stack of forms in the subpopulation without looking. Of course, this is a very crude way of random sampling. In the new pilot every form was given a unique number with a stamping machine. The computer program was adjusted and the random number generator of the computer program was used to randomly select the forms that should be in the sample.

We also made progress on finding the optimal sample size in the EOQL-method using the hypergeometric distribution. In fact we found a simple, elegant and fast way to find the optimal sample size. This method is described in Chapter 6. We called this method the Exact Expected Outgoing Quality Limit (EEOQL) method. The computer program was also adjusted such that it could calculate the optimal sample sizes using this new algorithm.

3.7.1 Results

This EEOQL-procedure inspected 17 subpopulations. Each subpopulation contained between 300 and 400 enrolments. We used a limit of zero errors in the sample. Using the improved method of finding the optimal sample size, this gave a sample size of 12 enrolments for all samples in the subpopulations where we used a limit of zero errors in the sample. If a previous sample was inspected integrally, thus an error was found, a limit of one error in the sample was used. Only one subpopulation was inspected integrally (the ninth). This subpopulation of 369 enrolments showed another two errors. Therefore, in the tenth subpopulation a limit of one error in the sample was used, resulting in a sample size of 27 enrolments. No errors were found in this sample.

A remark has to be made about the way the EEOQL-procedure was performed. We agreed to check on errors as defined above and other errors would also be reported on as experience data. These experience data are used to give an overall view of the precision and quality of the activities carried out by the workers. The inspection of these data is part of the control activities as described

in the COSO-report. The computer program gives the employee the opportunity to do so. In spite of these agreements the employees of SPD-enrolment decided not to report on the other errors after the second subpopulation and also they decided only to take the criteria $1i$ and $1j$ into account. Reason to do so was that for all other errors besides $1i$ and $1j$, they did not find it logical to improve these errors after the time that had passed since the actual enrolment took place. After the candidates enrol they receive a survey on which the information they supplied is registered. If the information was processed wrongly by the employees of SPD-enrolment the candidates can inform the employees of SPD-enrolment about this. Experience learns that candidates indeed are very keen on improving information that is directly linked with the exam, but are not so precise concerning background information. Criteria $1i$ and $1j$ are examples of this kind of background information. Because the actual enrolments are checked with the data in the computer there is some sense in this way of reasoning. The data in the computer do not represent the original input anymore. This original input has already been corrected for errors.

An evaluation showed that the employees who conducted the EEOQL-procedure were enthusiastic about this procedure and found it an excellent way to control their activities. However, they reported on the following drawbacks of the procedure.

- The EEOQL-procedure gives difficulty in planning the control activities. If the subpopulation is rejected, then the subpopulation has to be inspected integrally. Beforehand it is not known if this will happen, which complicates the planning of the EEOQL-procedure.
- Some employees told that they felt tempted to cover up mistakes that would lead to an integral inspection, because this would save them a lot of work.
- For numbering the enrolments an old-fashioned stamping machine was used. The employees found the use of this machine ergonomically irresponsible, and the machine was too noisy (they got complaints from employees from a floor beneath).

The stamping machine was just used in this experimental pilot and if the

EEOQL-procedure would be implemented on a regular basis, we are sure that more modern methods are available. We know that employees from ED take great pride in the quality of work they deliver, but to fight the temptation of covering up errors an examination of the inspection tasks is very important. An employee of ED especially concerned with control tasks within ED could do this. Otherwise, the aforementioned rotation of control tasks over the different clusters could be a solution. We agree that the EEOQL-procedure complicates the planning of future activities, but we are also sure that the organisation of ED is flexible enough to react to last-minute changes of their planning, because this is a phenomenon that ED is not unfamiliar with.

After these two pilots, manuals for the EEOQL-procedure and for using and adapting the computer program were handed over to ED. We thought they had gathered enough knowledge to conduct the EEOQL-procedure independently and plans were initiated to implement the EEOQL-procedure at other processes.

Shortly after these pilots the activities conducted for the SPD-exam were terminated because the IB-Groep unexpectedly lost the contract of organising this exam.

3.8 Conclusions

The EEOQL-procedure turned out to be an excellent tool for the internal control toolbox of the IB-Groep. It satisfied the objectives management had set for a new internal control procedure. Also it was practically performable and took the objectives of the COSO-report into account. Components of the COSO-report that needed further improvement were the effectiveness of the communication and the attitude towards internal control procedures. Despite the positive assessment of the EEOQL-procedure by the IB-Groep, it has not yet become a standard method in the internal control toolbox of ED. Notwithstanding that ED recognized the need to improve their internal control procedures in general and notwithstanding the positive assessment of the EEOQL-procedure, they did not improve and innovate the internal control procedures of their processes by implementing the EEOQL-procedure. Partly this could be put down to new developments in the organisation like the implementation of the new management model. At the moment this implementation takes place and the EEOQL-procedure does

not have the highest priority at the moment. The EEOQL-procedure will be reassessed after the new management model is operational.