

# Finnish Safety and EMC Market Surveillance Statistics

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## Abstract

In Finland, electrical safety and EMC market surveillance activities have been collected together in the TUV A database, which contains information on over 10,000 cases. In this paper, the TUV A database is statistically analyzed. The aim of this paper is to ascertain whether there is a potential use and usefulness for the application of these statistics when evaluating the effectiveness of the Finnish market surveillance of electrical equipment, and also, when in allocating market surveillance resources. The publishing of our statistical information will hopefully assist other market surveillance authorities, as well as entrepreneurs in their operations. The matters researched in this paper are the distribution of market surveillance findings with regards to 1) annual statistics and 2) different product categories. The analysis of safety and EMC findings has been carried out independently and then any potential correlation between results has been checked. Also, the durations of typical market surveillance cases over the period 1994-2000 have been analyzed.

## INTRODUCTION

In 1998, the Directorate General for Enterprise in the European Commission launched the Mutual Joint Visit Programme (MJVP), in which expert teams of market surveillance enforcement professionals from different member states in key regulatory areas visited other member states to assess their market surveillance systems. One of the MJVP's final remarks was that very little statistical data from market surveillance was available.

The Safety Technology Authority of Finland (TUKES) is a state agency, which is responsible for providing surveillance, development and safety communications services in its fields of operation as laid down by law. One of TUKES's tasks is the market surveillance of electrical appliances and accessories sold in Finland. The Finnish safety and EMC market surveillance system for electrical products is described in [1]-[3].

Depending on the seriousness of the defects found in products, TUKES usually applies one of the following measures:

- **A recall:** The importer or manufacturer may not deliver new products onto the market until the safety or EMC faults in question have been corrected. In this case, products must be withdrawn from the market and also from consumer hands.
- **A sales ban:** The importer or manufacturer may not deliver new products onto the market until the safety or

EMC faults in question have been corrected. In this case, products already on the market for sale must be withdrawn from wholesalers' and retailers' stocks.

- **A delivery ban:** The importer or manufacturer may not deliver new products onto the market until the safety or EMC faults in question have been corrected. However, those products, which already have reached the market, may be sold.
- **A caution:** A product has a slight safety or EMC fault, which should be corrected by the time the next product batch comes onto the market.

In Finland, the market surveillance authority regularly selects various pieces of electrical equipment for testing, which is performed in proven competent testing laboratories independent of TUKES. According to the Electrical Safety Act, TUKES is entitled to obtain product samples for testing purposes. The Finnish authority, in fact, purchases samples randomly at current retail prices. Since 1<sup>st</sup> September 1996, in cases in which products have proven to fail to conform with the regulations, the Finnish authority has stipulated repayment for the purchases, as well as for testing costs. TUKES passes on testing and purchasing costs to the manufacturer or importer of the product in question in recall, sales ban or delivery ban cases. Figure 1 shows the variable expenses of TUKES's market surveillance for electrical products and the repayments charged to manufacturers and importers.

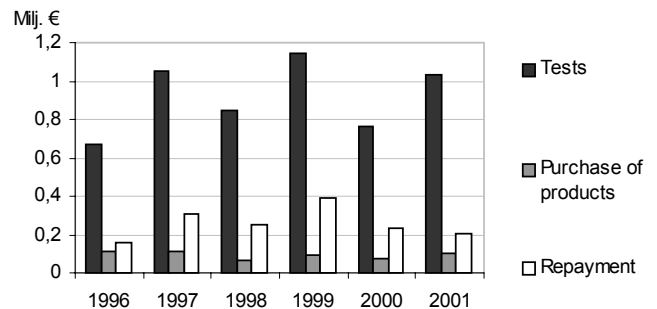


Figure 1. Market surveillance expenses and repayments charged to manufacturers and importers

In 1994, the advanced approval system for electrical equipment ended in Finland and the market surveillance system commenced. From the commencement of the new system, all market surveillance activities have been collected together in the so-called, TUV A database, which today contains information on over 10,000 cases. The extent of the TUV A database is internationally considered unparalleled.

## THE MATERIAL AND METHODS

### The Research Material

The research material for this paper consists of active market surveillance cases, which were collected up into the TUVU database between 1994-2000. In this paper, an *active market surveillance case* means that, according to the TUVU database, field inspectors from TUKES or its predecessor, SETI, launched the case during a market surveillance site visit e.g. by purchasing the product in question, as opposed to those cases in which a product was derived from another source e.g. in the case of complaints. In cases concerning active market surveillance, the TUVU database always contains information about the retailer, importer and/or manufacturer. If only the manufacturer has been associated with the case, then only those cases in which the manufacturer is Finnish have been included. Following this stipulation, the research material of this paper consists of 9007 cases.

It should be noted that all cases do not include the necessary information for all special studies in this paper, or possibly a case in question does not have the characteristics needed for special examination. For this reason, not all examinations for this paper cover all 9007 cases. The number of valid cases in the study in question is noted in the section for a specific examination.

### Methods used

In this paper, the TUVU database is statistically analyzed by using the SPSS program [4]. The research methods applied are: observational matrix, frequency analysis, correlation analysis and chi-square tests.

In this paper, the term *degree of discovery accuracy* means the share of cases, which have led to some measures being taken by TUKES, compared with other logged cases. The degree of discovery accuracy is used when comparing the effectiveness of market surveillance with regard to different background variables.

### ANNUAL STATISTICS

In this study, the market surveillance cases have been grouped according to the opening date of the case; typically the date that TUKES's field inspectors purchased the product in question for testing.

The main research questions when examining annual statistics were: 1) How the degree of discovery accuracy had changed over the years under study, and if there were any trends to be noticed? 2) If the commencement of charging for tests and purchasing by TUKES had in any way an influence on product compliance?

### Safety surveillance

Figure 2 shows that safety market surveillance findings have changed over the years. From the year 1997, which was the first complete year when TUKES charged test and purchase costs, the number of sales and delivery bans has noticeably decreased. Also, the number of products that

fulfill requirements has increased. The only deterioration in results can be seen in the number of recall cases, which have increased.

In fact, improvements could be seen as early as 1996. Then a fall in sales and delivery bans for safety reasons could be seen (see Figure 3). Since then, the trend has been positive. Only the number of products that have required recall measures has slightly increased.

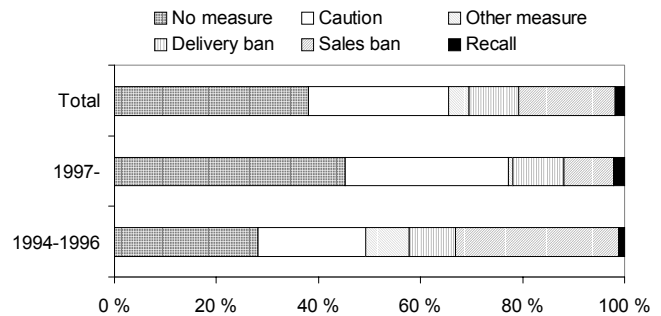


Figure 2. Safety findings before and after the commencement of test and purchase cost charging (n=8934)

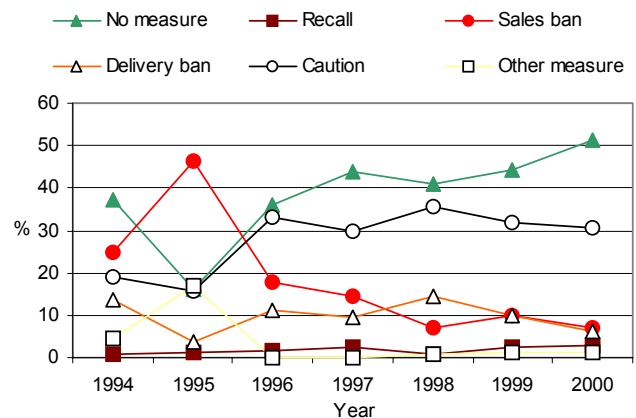


Figure 3. Safety surveillance measures (n=8934)

### EMC surveillance

In the period 1994-2000, TUKES had 364 active EMC market surveillance cases. Figure 4 shows the number and proportion of measures taken with regard to these cases. It should be noted that, in Finland, no recall procedure has been taken with regard to EMC issues.

Sixty-four EMC market surveillance cases are from the

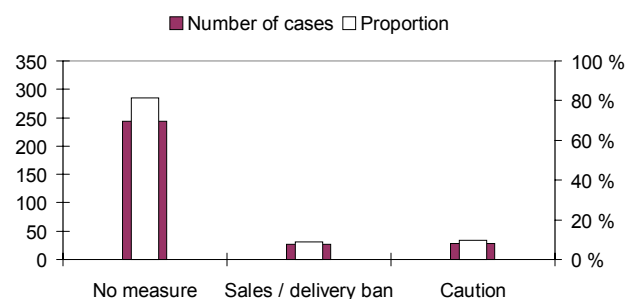


Figure 4. EMC surveillance measures 1994-2000 (n=364)

period before test and purchase cost charging, i.e., prior to the year 1997. None of them incurred any measures. In the period 1997-2000, TUKES had 300 EMC market surveillance cases. About 17 % of them required some measure and around half of the measures led to the charging procedure. About 50 % of the measures were cautions. Between the years 1997 to 2000, no statistical disparities could be observed in EMC market surveillance findings.

### Discussions

TUKES took no EMC market surveillance measures before the year 1997. So, the effect of the commencement of charging for testing and purchasing, in the case of serious EMC measures, cannot be estimated.

Figure 3 shows that safety market surveillance findings changed noticeably between 1994 and 2000. It can be seen, that TUKES's market surveillance had a considerable affect on the proportion of dangerous products on the Finnish market. In Sept. 1996, the commencement of the charging procedure quite possibly had a positive influence on compliance, but there are undoubtedly many other reasons that go towards the positive trend in product safety.

### DEVICE GROUP STUDY

#### Safety surveillance

The device group study is based on the device groups, which the Finnish competent testing laboratory SGS FIMKO Ltd. uses. It should be noted that these device groups are fairly wide and generalist. However, for finding reasonable and comparable statistical results, the number of groups is too large (24 groups). For this reason, the groups have been rendered into 13 groups, as shown in Table 1.

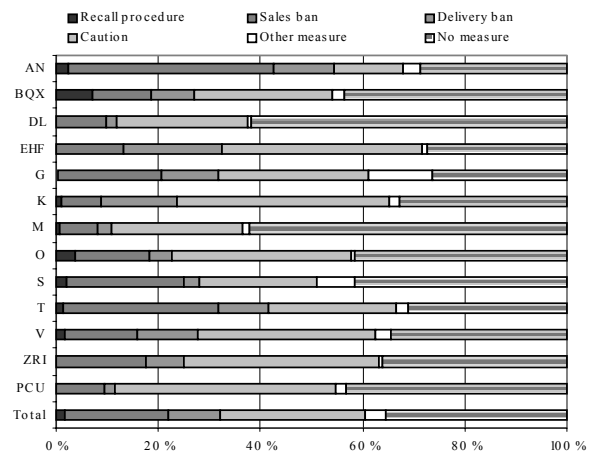
Table 1 shows, also, the numbers of electrical safety market surveillance cases within these combined device groups. Most of TUKES's market surveillance cases relating to electrical safety specifically relate to luminaires and light fittings (SGS FIMKO's device group T); every fourth tested product belonged to this group. The second largest group was electrical tools and machines (G; 17,4%). Other groups which got more than ten percent of surveillance, were IT equipment, office technology, and power supplies, including components (BQX; 12%) and entertainment electronics (V; 10,2%). The lowest number of cases is classified in the residual group (PCU; 0,6%), in which belong SGS FIMKO's device group *others* along with two other marginal groups.

The most severe market surveillance measure, *the recall procedure*, was compelled to be used most usually within the BQX-group (ITE etc.); 7.2 % of all tested products within this group came under this measure (see Figure 5). From all recall-cases that TUKES has instigated, almost 50 % were focused into the BQX-group. On the other hand, the number of sales and delivery bans is not high within this group.

**TABLE 1. Combined device groupings - Safety**

SGS FIMKO's device groups	Items	Number of cases	Proportion (%)
A, N	Installation accessories / connection plugs	670	8.0
B, Q, X	IT equipment / office technology / power supplies and components	1008	12.0
D, L	Hair, skin, body care / medical devices	235	2.8
E, H, F	Supply stations / switching, control and regulating devices / cables and wires	375	4.5
G	Electrical tools and machines	1458	17.3
K	Heating, plumbing and air conditioning	602	7.2
M	Food and drink processing, heating and storage equipment	578	6.9
O	Cleaning and sanitation	137	1.6
S	Clothing care	157	1.9
T	Lamps and luminaires	2066	24.6
V	Entertainment electronics	859	10.2
Z, R, I	Network protection, measuring and management / occupational safety engineering / energy meters and control devices	204	2.4
P, C, U	Others (e.g. animal husbandry, insect prevention)	53	0.6
<b>TOTAL</b>		<b>8402</b>	<b>100.0</b>

When considering all severe market surveillance measures (recalls, sales bans, delivery bans), these measures were compelled to be used most often within the AN-group (installation accessories, connecting plugs etc.). More than half of the cases within this group led to severe measures being taken. From a proportionate point of view, severe measures were second in number and were often located in the T-group (luminaires etc.). As many as 41.6 % of the cases within this most monitored group led to severe measures.



**Figure 5. The degree of discovery accuracy – Device group study - Safety (n=8402)**

The number of cases which have led to no measure being taken are located in groups AN, EHF and G. The percentage of tested products, which comply with safety requirements, is less than 30 % within all these groups.

On the other hand, the proportionate number of cases leading to measures is least in the product groups DL and M. In both groups, over 60 % of cases have not led to any measures being taken. Also, the proportion of severe measures is smallest in these two groups, together with the PCU-group.

### EMC surveillance

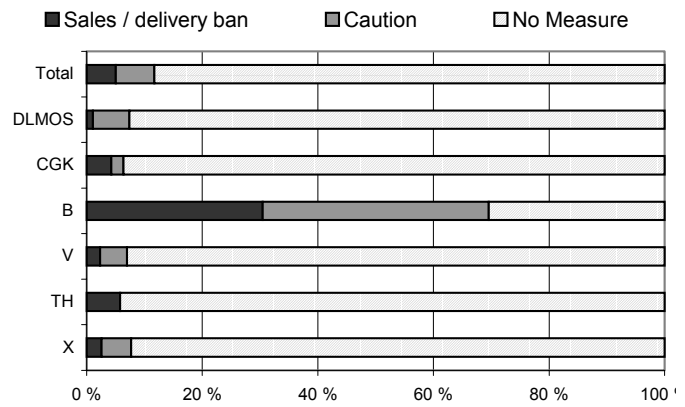
When studying EMC surveillance findings, the applied device groups are also based on SGS Fimko Ltd's groupings (see Table 2). However, a slightly different make-up of combined device groups is now reasoned, e.g. because of the scopes of EMC standards. In this study, only the cases, which were effective when the EMC Directive was mandatory, have been studied.

**TABLE 2. Combined device groupings - EMC**

SGS FIMKO's device groups	Items and 'New device group'	Number of cases	Proportion (%)
X	Power supplies and components 'Power electronics (PE)'	39	13.0
TH	Lamps and luminaires / Switching control and regulating devices 'Lighting equipment (L)'	52	17.3
V	Entertainment electronics (EE)	43	14.3
B	IT equipment (ITE)	24	8.0
CGK	Animal husbandry, insect prevention / Electrical tools and machines / Heating, plumbing and air conditioning 'Household equipment 1 (HH 1)'	47	15.7
DLMOS	Hair, skin, body care / medical devices / Food and drink processing, heating and storage equipment / Cleaning and sanitation / Clothing care 'Household equipment 2 (HH 2)'	95	31.7
<b>TOTAL</b>		<b>300</b>	<b>100.0</b>

Applying this grouping, most of the EMC market surveillance cases belong to the group *HH 1*; over 30 %. The share of other groups is about 15 %, except for the share of ITE that is 8 %.

Figure 6 shows the proportion of cases that have led to measures being taken. Although the grouping is rough, in order to get statistically valid results, solely the degree of discovery accuracy was studied. According to this study, TUKES's measures were compelled to be used most often within the ITE-group; almost 70 % of the EMC tested IT equipment led to a caution or sales/delivery bans. From all TUKES's EMC measures, almost 50 % were focused within the ITE-group. Within all other device groups, the proportion of measures was clearly below 10 %.



**Figure 6. The degree of discovery accuracy – Device group study - EMC (n=300)**

### Discussion

#### Safety surveillance

The degree of discovery accuracy in market surveillance for electrical equipment with regard to electrical safety was over 50 % for all device groups with the exception of two. Through the group classification method examined in this paper, the amount of market surveillance for electrical equipment is not focused equally on all product groups. Still, it should be noted that the degree of discovery accuracy has been exceedingly high in those device groups in which the market surveillance was focused. In three of the four device groups that have received at least a 10 % proportion of surveillance cases, the degree of discovery accuracy was over 60 %. Moreover, the fourth group (BQX) proportionately contained the highest number of cases leading to a recall procedure. A typical dangerous product in the BQX-group was a power supply pack for a personal computer.

In the TUV database, the dangerousness of the product linked with the market surveillance case in question has been recorded. On the other hand, the type of hazard has not been mentioned. The number of fatal electrical accidents caused by electric shock from faulty equipment is so minimal in Finland that statistical methods cannot be used to evaluate them. According to [5], the low number of electrical accidents results from efficient market surveillance, product responsibility legislation and general emphasis on quality development.

Unfortunately, electricity appears to be the cause of approximately 2,000 fires with 10 fatalities per year in Finland [6]. According to [6], the product categories, which cause most of the electrical fires in Finland, are electrical installations (18 %), stoves and ovens (17.5 %), televisions (11.9 %) and luminaires (10.9 %). These product categories, especially luminaires, have been well represented among the products tested for market surveillance purposes. Because electrical fires are regrettably rather common, it seems that in some product groups the technical requirements (harmonized standards) for preventing fire hazards are not adequate.

**EMC surveillance**

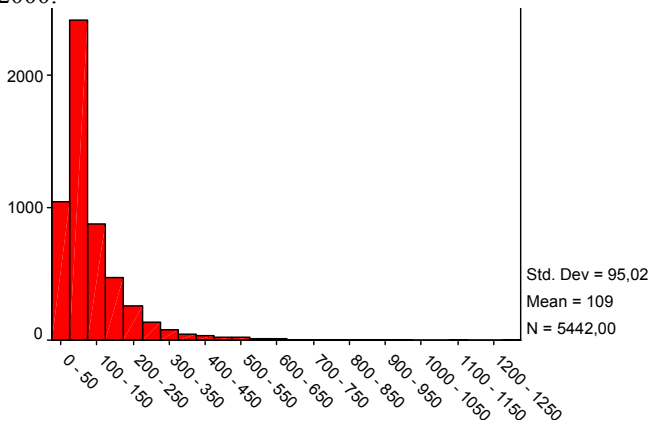
The most problematic device group in EMC market surveillance was IT equipment; almost 70 % of cases were a result of measures being taken by TUKES. The degree of discovery accuracy was under 10 % in other device groups. In spite of this, the share of IT equipment from all EMC market surveillance cases was smaller than that of other groups. Question: Should EMC market surveillance be more intensely directed towards IT equipment? In [3], the EMC problems related to PCs are discussed.

**THE DURATION OF SURVEILLANCE CASES**

In this section, information about the durations of market surveillance cases recorded in the TUVA database are studied.

**Total duration of cases**

The total duration of market surveillance case means the time that extends from the purchase of the product in question to the date when the case is officially closed. Figure 7 shows the distribution of the durations of all active safety cases that included product testing in 1994-2000.



**Figure 7. Total duration of safety cases**

When the safety cases are divided into two groups; 1994-1996 / 1997-2000 (see Table 3; left portion), statistical divergences can be seen in locations and geometries of these groups' distributions. The duration of market surveillance cases appears to have been shortened, as well as seeming to have become more stable with time. When examining cases leading to different measures (see Table 3; right portion), the durations of cases are different; the more severe the measure, the longer the duration. However, the durations of sales bans and delivery bans are equally

**Table 3. Total duration of safety cases**

	Valid cases	1994-1996	1997-2000	Recall	Sales ban	Delivery ban	Caution
N	5442	1898	3544	107	777	789	2261
Mean	109	120	103	187	154	152	95
Median	77	85	74	140	113	114	76
Mode	63	63	64	135	104	112	70
Standard deviation	95	103	90	150	127	120	66
Minimum	0	0	0	2	0	12	5
Maximum	1268	1268	1141	905	1268	1141	710
Lower quartile	55	57	54	85	77	79	60
Upper quartile	127	149	118	247	188	188	110

distributed (p=0.804).

No EMC case led to a measure before 1997. Between different EMC measures, no statistical fluctuation can be noted. The statistical parameters of EMC cases leading to a measure: mean=124, median=110, mode=46, standard deviation=93, minimum=23, maximum=329, lower quartile=47, upper quartile=151.

**The duration of case elements**

The duration of testing means the time that extends from the purchase of the product to the date when the test report for the product in question is signed. When looking at the period 1994 to 2000 in two time frames (see Table 4), the time of safety testing has evidently shortened and stabilized over time. In this case, too, the duration of testing is dependent on the measure in question, but in this case, the stricter the measure, the quicker the test.

**Table 4. The duration of safety tests**

	Valid cases	1994-1996	1997-2000	Recall	Sales ban	Delivery ban	Caution
N	5993	1941	4052	149	819	816	2337
Mean	47	56	42	36	46	50	58
Median	47	49	46	24	44	50	49
Mode	56	49	56	14	57	56	56
Standard deviation	27	37	20	33	31	30	26
Minimum	0	0	0	1	0	1	1
Maximum	432	288	432	210	288	277	432
Lower quartile	29	29	29	13	25	31	32
Upper quartile	57	69	56	50	57	58	57

When looking at TUKES's handling times from the date when safety test reports are completed to the final date when cases are closed (see Table 5), handling times have not relevantly changed over the years in question. Once again, statistical fluctuation can be found between different measures. As with the total duration, TUKES's handling time of sales and delivery ban cases appears to be equally distributed (p=0.068).

**Table 5. Handling time after safety tests**

	Valid cases	1994-1996	1997-2000	Recall	Sales ban	Delivery ban	Caution
N	5390	1888	3502	106	765	788	2251
Mean	57	59	56	146	103	97	42
Median	22	23	22	109	60	55	20
Mode	0	6	0	45	42	6	7
Standard deviation	90	94	88	142	121	117	61
Minimum	0	0	0	1	0	0	0
Maximum	1232	1232	1080	833	1232	1080	182
Lower quartile	6	7	6	45	34	27	14
Upper quartile	67	66	68	200	131	122	49

The durations of EMC cases and their elements are independent of the measure in question. Table 6 shows the durations from product purchasing to the date when EMC tests are completed, and the durations of TUKES's handling times following EMC testing. When looking at the period 1994 to 2000 in two time frames, the time of EMC testing has evidently shortened and stabilized over time. When looking at handling times, distinct statistical fluctuations can be found. However, it should be remembered that the number of cases before 1997 was low and the EMC market surveillance system was not so well established at that time.

**Table 6. Durations of EMC case Elements**

	Testing time			Handling time		
	Valid cases	1994-1996	1997-2000	Valid cases	1994-1996	1997-2000
N	253	34	219	190	29	161
Mean	31	62	26	87	116	81
Median	24	42	23	61	91	55
Mode	14	28	14	7	146	7
Standard deviation	33	53	26	86	70	87
Minimum	0	4	0	0	41	0
Maximum	314	226	314	498	295	498
Lower quartile	15	30	14	26	53	20
Upper quartile	34	75	29	126	161	99

## Discussion

The handling of safety cases has speeded up and become more stable in its all components over time. Today, a typical safety case lasts about 10 weeks and the mean value of durations is below 15 weeks. TUKES's EMC market surveillance practice stabilized after 1997, therefore no annual trend can be seen from the EMC case material of this study.

When comparing safety cases leading to different measures (see Figure 8), it can be seen that the more serious the measure, the more protracted the duration. On the other hand, the testing time is shortened in serious cases. The testing time consumes more than 60 % of the total duration of caution cases. In sales/delivery ban cases it is about 30 %, and in recall cases less than 20 %.



**Figure 8. Segmentation of safety case durations by different measures** (presented durations are mean values)

## CONCLUSIONS

The TUVa database was established as an every-day tool for handling market surveillance cases with regard to

electrical equipment. Today, the database contains information on over 10,000 market surveillance cases and its extent is internationally considered unparalleled. Although the TUVa database is not established for gathering up statistical data, this study showed that the database could also be applied as a source of statistical study.

According to *the annual statistics study*, the slightly increasing share of market surveillance cases relating to electrical safety do not lead to any measures being taken. This indicates that, also, the number of non-conforming products on the Finnish market is slightly declining.

*The device group study* shows that the market surveillance of electrical products is focused quite reasonable on different device groups although, especially the intensity of EMC surveillance could be concentrated more effectively and efficiently. Also, from the standpoint of electrical fires, TUKES's market surveillance is reasonably well focused. Still electrical fires are unfortunately rather common. That indicates that not all technical requirements are adequate. If the requirements are too lenient, market surveillance has no tools or teeth for stopping the entry of hazardous products onto the market at this time.

*The case duration study* shows that TUKES's market surveillance cases have speeded up and typically last about 10 weeks. It also shows that the more serious the findings found, the quicker products were tested. Nonetheless, the total duration of serious cases is longer than in less serious cases. In this study, the test report handling and decision making times, before measures were issued to the parties involved, have not unfortunately been studied. This might be a subject for future study.

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