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Market Surveillance of Electrical Equipment in Finland

Analysis and Development

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THE SAFETY TECHNOLOGY AUTHORITY

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Tiivistelmä

Markkinavalvonnan tärkeys on todettu monissa kansallisissa ja kansainvälisissä yhteyksissä. Ilman markkinavalvontaa ei voida varmistaa markkinoilla olevien tuotteiden täyttävän asetettuja vaatimuksia - tärkeimpänä turvallisuus – eikä taata toiminnanharjoittajien tasapuolista kohtelua. Toimiva ja tehokas markkinavalvonta vaatii merkittävää erikoisammattitaitoa ja panostusta. Suomessa markkinavalvontaan on varattu vuosittain noin 8,5 M€ budjettivaroja. Näistä tosiasioista huolimatta markkinavalvonnasta ei juuri löydy tutkimustietoa miltään tuotealueelta. Suomessa sähkölaitteiden valvonta muuttui ETA-jäsenyyden myötä vuoden 1994 alusta. Nykyään valvonta perustuu kansainvälisiin velvoitteisiin ja siitä huolehtii pääosin Turvatekniikan keskus (TUKES). Suomessa on panostettu huomattavasti sähkölaitteiden valvontaan ja tämä onkin saanut osakseen sekä kotimaista että kansainvälistä arvostusta.

Tämän tutkimuksen tarkoituksena oli selvittää [1)] turvaako nykyinen ohjausjärjestelmä (tärkeimpänä lainsäädäntö ja sitä tukevat tekniset standardit) sähkölaitteiden turvallisuuden ja muun vaatimustenmukaisuuden; sekä [2)] toimiiko TUKESin markkinavalvonta tarkoituksenmukaisesti ja täyttääkö se modernin viranomaisvalvonnan periaatteet. Näiden selvitysten jälkeen tuli määrittää, miten toisaalta ohjausjärjestelmää ja toisaalta TUKESin toimintaa tulisi entisestään kehittää, jotta kansalaisten ja toiminnanharjoittajien tarpeet täyttyisivät entistä paremmin nyt ja tulevaisuudessa.

Tutkimuksen empiirinen osa koostui neljästä osa-alueesta. Näistä yhdessä arvioitiin TUKESin sähkötuotevalvontaa Euroopan laatupalkintokilpailun kriteeristön avulla. Toisessa osa-alueessa selvitettiin haastattelututkimuksin valvontakohteiden toimintatapoja sekä heidän näkemyksiään ja kokemuksiaan markkinavalvonnasta. Haastateltavat toiminnanharjoittajat valittiin TUKESin **tu**ote**va**lvonta- (TUVA-) tietokannasta, joka sisältää tiedot kaikista Suomessa sähkötuotteisiin kohdistuneista markkinavalvontatapauksista vuodesta 1994 lähtien – yhteensä yli 10 000 tapausta. Varsinainen tutkimusaineisto koostui kymmenen maahantuojan syvähaastattelusta sekä 101 toiminnanharjoittajan puhelinhaastattelusta. Kolmannen osa-alueen muodostivat TUKESin markkinavalvontahankkeet kohdistuen laitteiden sähkömagneettiseen yhteensopivuuteen (EMC). Ne toteutettiin 1997-2002 ja ne kohdistuivat EMC-ominaisuuksiltaan ongelmallisiksi havaittuihin tuoteryhmiin: katkeamattoman virransyötön laitteet, mikrotietokoneet, taajuusmuuttajat ja energiansäästölamput. Kussakin hankkeessa testattiin tyypillisiä tuoteryhmään kuuluvia laitteita, analysoitiin tulokset ja arvioitiin kyseisen tuoteryhmän EMC-vaatimusten järkevyys niin tekniseltä kuin hallinnolliselta kannalta. Neljännessä osa-alueessa analysoitiin tilastollisesti TUVA-tietokantaa. EMC-valvonnan vertailutiedoksi tutkittiin myös Viestintäviraston ja Digita Oy:n ylläpitämiä häiriötilastoja.

Markkinavalvonnan päätarkoitus on valvoa järjestelmän toimivuutta eli sitä että kaikki osapuolet täyttävät heille asetetut velvoitteet. Tutkimus osoitti että sekä ohjausjärjestelmä että TUKESin markkinavalvonta pääosin toimivat, vaikkakin molemmista löytyy kehitettävää. Ohjausjärjestelmän suurimmat ongelmat löytyvät teknisistä standardeista. Toinen suuri ongelma on että markkinavalvonnan taso vaihtelee huomattavasti Euroopan talousalueella. Järjestelmänä nykymuotoinen markkinavalvonta soveltuu etenkin sarjatuotantotyyppisille kuluttajatuotteille, mutta yksittäisten tai pieninä sarjoina valmistettavien tuotteiden valvonta on hankalampaa. Markkinavalvonnalla ei myöskään pystytä aina vaikuttamaan sellaisten laitteiden yhteensopivuuteen, joissa sähkömagneettiset ominaisuudet riippuvat suuresti laitteen asennus- tai käyttötavasta tai paikasta. Jos laitteen valmistaja on määritellyt nämä omalta kannaltaan riittävän tarkasti, ei viranomaiselta löydy toimivaltaa, koska EMC-lainsäädäntö ei vaadi, että tuote tulisi suunnitella huomioiden oletettavissa olevat väärät käyttötavat. Turvallisuuspuolellahan tämä vaatimus löytyy.

Tehokkaimmin vaarallisten tai sähkömagneettisesti yhteensopimattomien sähkölaitteiden tulo markkinoille voitaisiin estää, jos lainsäädäntö ja yleinen ilmapiiri kehitettäisiin sellaiseksi, että olisi taloudellisesti kannattavampaa huolellisesti varmistaa valmistettavan, maahantuotavan ja/tai myytävän laitteen turvallisuus ja sähkömagneettinen yhteensopivuus kuin pelkästään pyrkiä minimoimaan vaatimustenmukaisuuden osoittamisesta aiheutuvat kustannukset. Suomi on niin pieni markkina-alue, etteivät suuret kuluttajasähkötuotteiden valmistajat tuota sitä varten omia tuotteita. Suomen markkinoilla esiintyvien sähkölaitteiden vaatimustenmukaisuuden parantumiseen nykyisestä vaikuttaneekin enemmän Euroopan laajuisen markkinavalvonnan kehittyminen kuin TUKESin toiminnan tehostaminen. TUKESin kannattaakin panostaa kansainväliseen markkinavalvontayhteistyöhön – kuitenkaan unohtamatta ’omaa tonttiaan’. Nykyään tuotteet liikkuvat ympäri maapalloa uskomattomalla nopeudella. Pidemmän tähtäimen tavoitteeksi tulisikin asettaa korkeatasoiset yleismaailmalliset turvallisuus- ja EMC-vaatimukset sekä näiden kattava valvonta.

Abstract

The importance of market surveillance has been recognised by many agencies and individuals in many contexts. Without market surveillance, the conformity of the products on the market, as well as the common playing field for entrepreneurs, can not be guaranteed. Safety is the most important aspect of conformity. For the realistic realisation of market surveillance, exceptional resources are called for; it can not be done superficially and needs total commitment. About 8.5 M€ has been allocated to market surveillance in Finland annually. Irrespective of these facts, very little research has been carried out on the market surveillance of any product field. The safety and environmental compatibility enforcement of electrical equipment in Finland changed in 1994 when Finland joined the European Economic Area (EEA). Today, supervision is based on international obligations and TUKES is responsible for maintaining it in Finland. Finland has invested considerably in the surveillance of electrical products, and TUKES has a recognised reputation for its work in Finland and abroad.

The aim of this research was to clarify [1)] if today's governing systems (legislation, standards, etc.) ensure that electrical equipment is safe and compatible; and [2)] if TUKES's market surveillance is appropriate for today's needs and if it fulfils the principles of modern authority supervision. Following these clarifications, this research specified the means and methods as to how the governing systems and TUKES's operations should be improved so as to better fulfil the needs of citizens and entrepreneurs now and in the future.

The empirical study consisted of four parts. One of them assessed TUKES's market surveillance of electrical products by utilising the European Foundation for Quality Management criterions. Another part examined through interview surveys, the way importers of electrical equipment operate and the expectations and opinions of subjects of supervision with regard to how TUKES carries out surveillance. The interviewed individuals were selected from TUKES's product consistency enforcement database (the TUVA database), which contains information on all market surveillance cases with regard to electrical equipment in Finland since 1994; to date over 10,000 cases have been recorded. The actual research material consisted of profound face-to-face interviews with ten importers and a telephone survey of 101 entrepreneurs. The third part of the empirical study was composed of TUKES's market surveillance projects that inspected the electromagnetic compatibility (EMC) of products. The projects were carried out 1997-2002 and they were directed to equipment groups whose EMC features had been known to be problematic: uninterruptible power supplies, personal computers, frequency converters and energy-saving lamps. In each project, typical products of this group were tested, results were analysed and the

reasonableness of products' EMC requirements were evaluated from technical, as well as administrative points of view. In the fourth part of the empirical study, the TUVA database was statistically analysed. Also, the Finnish Communication Regulatory Authority's and Digita Ltd's interference statistics were researched for provision of comparative information for analysing TUKES's EMC surveillance.

The main focus of market surveillance is to inspect the operation of the "system" and to see that all parties concerned observe their responsibilities. This research indicated that both the governing systems and TUKES's market surveillance met expectations, even though there was room for improvement. The biggest problems in governing systems were found to be in technical standards. Another big problem is the fact that levels of market surveillance in the EEA are very different. Market surveillance is a good system for supervising series products intended for the normal consumer. On the other hand, the supervision of non-serial products as well as business-to-business products is much more complicated. Unfortunately, market surveillance does not make it possible to have an influence on the compatibility of products, whose electromagnetic features mostly depend on the method of installation and how and where they are used. If the manufacturer has specified these aspects so as to fulfil his/her own vested interest, the Authority has no tools. This is because legislation concerning EMC does not require that a product be manufactured so as to cater for any possible impending misuse. From the safety legislation point of view, this requirement is strictly observed.

The most effective way to prevent the appearance of more dangerous or non-compatible electrical equipment is to change legislation and general attitudes so that it should always be more profitable and rewarding to follow the safety and conformity rules, which is far better than trying to do the conformity assessment procedure at as low a price as possible. Finland is a small market area and for this reason, global manufacturers are not interested in making products solely for the Finnish market. It is reasonable to believe that improvements in only TUKES's own market surveillance would hardly reduce the number of non-conforming products on the Finnish market. If market surveillance were effectively operational throughout the EEA, manufacturers would be driven to invest more in the quality and conformity of their products. TUKES must actively strive towards better and more effective EEA-levels of market surveillance, at the same time, nevertheless not neglecting its prime responsibilities in monitoring the Finnish market. Today, goods flow around the world at unbelievable speed. In the long term, global safety and EMC requirements as well as their enforcement throughout should be the target to aim for.

Preface

For me, it has been a great joy and a challenge to work on this dissertation. Therefore, I hope that the reader will find it not only interesting but also enlightening and enjoyable to read.

The research reported here has been prepared at the Safety Technology Authority (TUKES), Helsinki, Finland, during the years 1997 – 2002 in conjunction with TUKES's basic operations; surveillance, communications and R&D. I am greatly indebted to many persons for helping me to complete this dissertation.

The work has been performed under the supervision of Professor Jorma Kyyrä. I express my gratitude to him for his support and wise advice throughout the whole of my postgraduate studies, in fact from 1991. Jorma is a very gifted and dedicated professor, and I consider myself fortunate to have benefited under his guidance.

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Helsinki, November 2002

Jyri Rajamäki

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List of Publications

This thesis consists of an introduction and the following nine publications, which are referred to by [P1]-[P9] in the text:

[P1] J. Rajamäki, S. Tuominen, V.-P. Nurmi, R. Mattinen and H. Mattila, "EMC and LV Directive Enforcement in Finland – an Analysis Using the EFQM Model", in *Proceedings of the2nd WSEAS International Conference on Nanoelectronics and ElectroMagnetic Compatibility (ICONEMC 2002),* Skiathos, Greece, September 2002, pp. 1921-1926. ISBN 960-8052-68-8.

[P2] J. Rajamäki and M. Rusanen, "The Consequences of Electrical Safety for Importers of Consumer Products," in *Proceedings of the 2002 IEEE International Symposium on Consumer Electronics (ISCE'02*), Ilmenau, Germany, September 2002, pp. J-1 – J-10. ISBN 3-910159-48-6.

[P3] J. Rajamäki, "Manufacturers' and Importers' Opinions on Finnish LVD and EMCD Market Surveillance," in *Proceedings of the EMC Europe 2002 International Symposium on Electromagnetic Compatibility*, Sorrento, Italy, September 2002, pp. 551-556.

[P4] J. Rajamäki, "EMC Testing of UPS Systems in Finland", *Compliance Engineering*, vol. XVII, No.4, May/June 2000, Canon Communications LLC Publication, pp. 56-65. ISSN 0898-3577. (http://www.ce-mag.com/archive/2000/mayjune/rajamaki.html)

[P5] J. Rajamäki, "How to get EMC Matters into Good Order with your Clone Micro Computer", in *Proceedings of the 2000 IEEE International Symposium on Electromagnetic Compatibility*, Washington D. C., USA, August 2000, pp. 657-662. ISBN 0-7803-6571-2.

[P6] J. Rajamäki, A. Kasanen and M. Axelsson, "An EMC Market Surveillance Project for Frequency Converters in Finland", in *Symposium Record of the 2001 IEEE International Symposium on Electromagnetic Compatibility*, Montréal, Canada, August 2001, pp. 94-99. ISBN 0-7803-6569-0.

[P7] J. Rajamäki and A. Kasanen, "An EMC Market Surveillance Project on Energy-Saving Lamps in Finland", in *Proceedings of the Sixteenth International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility*, Wroclaw, Poland, June 2002, pp. 573-578. ISBN 83-916146-0-3.

[P8] J. Rajamäki, "Finnish Safety and EMC Market Surveillance Statistics", in *Proceedings of the 2002 IEEE International Symposium on Electromagnetic Compatibility*, Minneapolis, USA, August 2002, pp. 686-691. ISBN 0-7803-7264-6.

[P9] J. Rajamäki and T. Laanti, "Correlations Between the Interference Statistics of Finnish Radio Systems and EMC Market Surveillance in Finland", in *Proceedings of the URSI XXVI Convention on Radio Science and Second Finnish Wireless Communications Workshop*, Tampere, Finland, October 2001, pp. 157-162.

List of Abbreviations

ADCO	Administrative Cooperation Working Group
AV	Audio Visual
CE	Communauté Européene, (eng.) European Community
CEN	Comité Européen de Normalisation, (eng.) European Committee for Standardization
CENELEC	Comité Européen de Normalisation Electrotecnique, (eng.) European Committee for Electrotechnical Standardization
DG	Directorate General
DoC	Declaration of Conformity
EC	European Community / European Communities
EEA	European Economic Area
EFQM	European Foundation for Quality Management
EFTA	European Free Trade Area
EMC	Electromagnetic Compatibility
EMCD	EMC Directive
EMI	Electromagnetic Interference
EN	European Norm, European Standard
EOTC	European Organisation for Conformity Assessment
ETSI	European Telecommunication Standardization Institute
EU	European Union
EUT	Equipment Under Test
FICORA	Finnish Communications Regulatory Authority
GA	Global Approach
GPSD	General Product Safety Directive
HH	Household
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electrotechnical Commission
ISM	Industrial, Scientific and Medical
IT	Information Technology
ITE	Information Technology Equipment
ITU	International Telecommunication Union
KTM	Kauppa- ja teollisuusministeriö, (eng.) the Ministry of Trade and Industry

LV	Low Voltage
LVD	LV Directive
MD	Machinery Directive
MJVP	Mutual Joint Visit Programme
MRA	Agreement on Mutual Recognition
MS	Member State
NA	New Approach
NB	Notified Body
OJEC	Official Journal of the European Communities
PC	Personal Computer
PPED	Personal Protective Equipment Directive
RAPEX	Rapid exchange of information
R&D	Research and Development
R&TTE	Radio and Tele Terminal Equipment
R&TTED	R&TTE Directive
SDoC	Supplier's Declaration of Conformity
SESKO	Suomen Sähköteknillinen Standardisoimisyhdistys SESKO ry, (eng.) Electrotechnical Standards Association
SETI	Sähkötarkastuskeskus, (eng.) Electrical Inspectorate
SFS	Suomen Standardisoimisliitto SFS ry, (eng.) Finnish Standards Association SFS
SOGS	Senior Officials Group for Standardization
SWEDAC	Swedish Board for Accreditation and Conformity Assessment
TC	Technical Committee
TCF	Technical Construction File
TD	Toys Directive
TTK	Tekninen tarkastuskeskus, (eng.) Technical Inspection Centre
TUKES	Turvatekniikan keskus, (eng.) Safety Technology Authority
UPS	Uninterruptible Power Supply
VANK	Vaatimustenmukaisuuden arviointiasioita käsittelevä neuvottelukunta, (engl.) Advisory Committee for Conformity Assessment Affairs
WSEAS	World Scientific and Engineering Academy and Society

List of Symbols

n	number of samples
p	probability

1. Introduction

Today, the safety of electricity is generally considered to be guaranteed. Electrical safety is governed predominantly by the rules of society. The system is based on the skill application of professionals, with technical requirements laid down in the standards which were set by professionals. Authority supervision and spot checks are also essential for smooth operation. The knowledge and skills of electricity consumers also have a great influence on the safety of electricity. The use of electricity has expanded dramatically during recent decades, but at the same time, the number of serious accidents relating to electricity has been reduced notably.

There are around 100,000 different types of electrical appliances on the Finnish market. Most of these comply with electrical safety requirements. Nevertheless, each year hundreds of products of less than perfect electrical safety appear on the market. A few dozen types of product which could result in being a danger to human life are revealed every year.

1.1 Over 100 Years of Electrical Safety Work in Finland

The hundredth anniversary of the first establishment of Finnish electrical safety statutes was celebrated at the beginning of 2002. Over the past century, the regulations have changed and developed considerably along with techniques, technology and the uses of electricity. The main goal of regulations is still the same: electrical equipment and installations are not allowed to involve any danger to life or property. [Suo02].

In April 1901, Tsar Nikolai II ratified a law with regard to "electricity plants for the purpose of light generation or power transmission" [i]. The law came into effect 1.1.1902 and there was stated that e.g., "if a plant can cause life or property danger, let it not be established or used before a licence for the plant has been obtained". In Finland, the fixed production of electricity had begun 20 years earlier; in 1882. At that time Thomas Alva Edison delivered an electricity production plan to Finlayson, Tampere, through which the weaving shop of a cotton plant could be illuminated [Lin94]. So, very soon after beginning to the use of electricity, it seemed to be necessary to specify general rules for electrical safety.

In the beginning of 20th century, electricity became common throughout Finland. At the end of 1930's, half the households in the countryside and almost all urban homes had electricity. Safety regulations developed along with electrification. The second law concerning electrical safety came

[i] Original: "Laki sähkölaitoksista valon synnyttämistä tahi voimansiirtoa varten", Annettu Helsingissä 11 p:nä huhtikuuta 1901, SUOMEN SUURIRUHTINANMAAN ASETUS-KOKOELMA N:o 9, 1901. (In Finnish).

into effect in 1929. It decreed that the surveillance of electrical safety was given to the Electrical Inspectorate, which was established to assist the Ministry of Trade and Industry. The Electrical Inspectorate took care of 'authority tasks', and was responsible for not only the surveillance of electrical installations and elevators but also the carrying out of the testing of electrical equipment. Actually, the Electrical Inspectorate was not a governmental authority, but an association, which had a position as an authority bestowed by statute. The organisations of the electrical branch were the driving force behind the Electrical Inspectorate at that time. The legislation concerning electrical safety changed in 1980, and with the new law the Electrical Inspectorate converted into public corporation.

The next legislative change came in 1995 and then, for the first time in Finnish history, the surveillance of electrical safety was given to a State organisation. A new authority, the Safety Technology Authority (TUKES), was given the authority function for electrical safety; the market surveillance of electrical products and the surveillance of electrical installations and installers as well. Following this, today' electrical safety rules have been laid down under The Finnish Electrical Safety Act (410/1996) and other statues given by virtue thereof. TUKES operates as a surveillance authority, but the principles of surveillance are very different in comparison with those of the times of The Electrical Inspectorate, when the authority had specific instructions for the electric branch. Today's statutes point out the responsibility of professionals in the electric branch with regard to the safety and conformity of products and installations. So, the basic idea behind today's regulations is very similar to that of the law going back a hundred years.

1.2 In Pursuit of Successful Surveillance

The European Community (EC) concept fully matured in 1992 with the creation of a single market for goods and services. Today, the European Economic Area (EEA) is made up of the 15 Member States (MS) of the European Union (EU) and the European Free Trade Area (EFTA) countries Norway, Iceland and Liechtenstein. The EEA has a population approaching 400 million. The unfettered transfer of goods and services across the boundaries of the MSs has been supported by the development of EC legislation and supporting product standards including those in the area of consumer safety. The creation of the legal framework is an essential prerequisite for ensuring that the single market guarantees effective consumer protection and, at the same time, uniform competition conditions for all enterprises.

The Finnish technical safety control system was thoroughly restructured with the application of The European single market guidelines in the 90's. The following principles were then agreed [Ahv00]: [1)] the laying down of norms, that is, authority operations, and evaluation operations

maintained separately, [2)] the redefinition of authority operations, [3)] the setting up of a few authorities from many organizations which had Authority status and also many other responsibilities, [4)] the streamlining of control procedures, [5)] the opening up of inspection services to competition, [6)] the condensing of cooperation between administrative sectors, [7)] essential State financing, and [8)] increased cost-effectiveness. Today, public investment for monitoring and surveillance comes to tens of millions of euros per year. In Finland, the annual national investment from the State budget for market surveillance is about 8.5 M€ [VAA02]. Together with the surveillance required for production, occupational health, environmental safety etc. the total comes to approximately 30 M€.

The Finnish legislation regarding product safety has been mainly harmonised with the EC legislation [OSH97]. The requirements and regulations for products in harmonised areas are today similar to those in the other EEA countries. The product requirements are based on EC directives, which were transposed into Finnish national legislation as appropriate. The corresponding safety requirements in the EEA presume that products should not cause danger to human well-being, environment or property. The primary responsibility for the safety of products falls on manufacturers and importers. The purpose of surveillance carried out by authorities is to ensure that regulations are followed and no dangerous or deficient products are available on the market. When necessary, dangerous and non-compliant products are withdrawn from the market. The basic principle of market surveillance in the EEA means that the consumer can trust that products manufactured or placed on the market for the first time in other EEA country are as safe as products you can buy in your home country. Another important intention of market surveillance is to ensure that the single market has a level playing field for all commercial goods and entrepreneurs.

The requirements for electrical equipment are established by different directives; among others, the Low Voltage Directive (LVD) [ii] which requires that all electrical equipment for sale must be safe, and the EMC Directive (EMCD) [iii] which deals with **e**lectro**m**agnetic **c**ompatibility between electrical equipment. According to the New Approach (NA) directives, the European Commission must be informed, if the free movement of products is in any way hampered. On the other hand, directives concerning electrical equipment state very little with regard to market surveillance and, so, there are major differences among MSs in how market surveillance is carried out. The General Product Safety Directive (GPSD) should be applied secondarily, if the specific legislation for the

[ii] Council Directive 73/23/EEC of 19 February 1973 on the harmonisation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits. Amendment 93/68/EEC.
[iii] Council Directive 89/336/EEC of May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility. Amendments 92/31/EEC, 93/68/EEC (and 98/13/EC).

products concerned is not precise enough. The GPSD [iv] includes requirements for producers[v] and distributors, as well as, for conformity assessment procedures and for MSs. The main obligations for the MS are:

- to take actions, which cause producers and distributors to heed their responsibilities. In particular, MSs shall establish or nominate market surveillance authorities which have the necessary powers to take the appropriate measures including the possibility of imposing suitable penalties in the event of failure to comply with the obligations derived from the directive.
- to inform the Commission of measures which restrict the placing of products on the market or require their withdrawal from the market. The Commission investigates the grounds and if it concludes that the measure is justified, it informs all MSs about the case in question.

Active enforcement collaboration between MSs is very important. In principle, all EEA countries work in cooperation; exchanging experiences, good and bad, and resolving special problems. European **Ad**ministrative **Co**operation working groups (ADCO) for market surveillance have been established, e.g. the areas of the LVD and EMCD. In 1998, the Commission launched the Mutual Joint Visit Programme (MJVP), in which expert teams of market surveillance enforcement professionals from different MSs in five regulatory areas visited other MSs to assess and appreciate their market surveillance systems. In 2001, this programme was continued and extended for new regulatory areas. At Nordic level, a reference group for market surveillance has been formed and it has carried out a study [SWE99] to determine contact points and activities for Nordic Cooperation.

1.3 Market Surveillance Recognised

The market surveillance of products placed or taken into use on the EEA market, is a prerequisite for the implementation of EC directives according to the New Approach (NA) principle [vi]. During recent years, a high premium has been placed on market surveillance and it is recognised as being vitally important to the European single market because markets depend on confidence in order to work properly. The following remarks confirm this belief: “Legislative measures alone are not enough. Surveillance of how the measures are working ‘on the ground’ is needed to ensure a level playing field and the confidence of companies and citizens – whether as consumers, workers or other users. In the context of the enlargement of the EU, an increasingly high priority is of course being placed upon ‘horizontal’ aspects, such as market surveillance and the need for the fullest

[iv] Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety; came into force 15 January 2002, must be transposed by the Member States into national law by 15 January 2004.
[v] Producer shall mean: the manufacturer, trade mark owner, person who reconditions the product, the manufacturer’s representative, the importer if there is no representative established in the Community, or other professionals in the supply chain if their activities may affect the safety properties of the product.
[vi] Council Resolution on a New Approach to technical harmonisation and standardisation, 7.5.1985.

cooperation between national market surveillance bodies", [Mon97]. "Confidence is vital if the Single Market is to function effectively: consumers must have confidence in product safety; economic operators must trust in a level playing field; third country manufacturers must be assured that they will not suffer discrimination", [Gad00]. "The functioning of the EU's single-market program depends on the vigilance of manufacturers in ensuring that products meet essential health and safety requirements, and on the product monitoring performed by national authorities once products are on the market. This monitoring, called market surveillance, is critical for maintaining consumer and business confidence in the present conformity assessment system", [Ett00].

The study of 'the impact of technical barriers to trade and product surveillance on the functioning capability of Finnish companies in the European Single Market' [Pir01] showed that, according to Finnish companies, market surveillance does not operate well enough in the EEA, and a whole EEA comprehensive market surveillance system, in which authorities' roles and means (legal basis) should be clearly specified and adequate resources for maintaining the system, have to be guaranteed. Also, European industry is becoming more outspoken on the need for improving market surveillance and, in some cases, industry has refused to accept higher product standards if surveillance is not drastically improved [Ett00]. Market surveillance is seen as necessary to avoid the potential harm and damage caused by unsafe products and that also can have a negative influence on the market for safe products [Fis00]. Market surveillance is primarily a governmental task, but also industry and trade have an interest in keeping unsafe products away from the market and they are willing to contribute towards the effort [Fis00], [Hen00]. To be effective, market surveillance must be publicised and should release information regarding product test results, both positive and negative ones [Fis00]. According to Finnish trade associations [Hen00], the biggest problem in European trade is that not all market surveillance authorities have enough resources. From the consumer organization point of view [Van00], consumers should be able to buy safe products, comfortable with the knowledge that they do comply with the requirements of the appropriate legislation. The experience of consumer organisations and market surveillance authorities, nevertheless, clearly demonstrates that there are significant numbers of dangerous products still circulating in Europe today.

In 1997, the European Council adopted the Single Market Action Plan, which outlined how the functioning of the single market needs to be improved. At that time, it had thus become evident that the existing requirements for market surveillance were too general to create a level playing field and effective consumer protection. In 1997, market surveillance gained a permanent forum for discussion in the EC's Senior Officials Group for Standardization (SOGS), and also, the first European Conference on Market Surveillance was organized by the EC, the Swedish government,

and SWEDAC. At that time, it was apparent that European enforcement collaboration was essential for improvement, but it could only be said that discussion on and development of criteria regarding market surveillance was quite a rare thing, unfortunately. Since 1997, market surveillance questions have remained at the top of the NA agenda. In 1999, the so-called 'Blue Guide' [EC99][vii] was completed; it contains a notable chapter on market surveillance and further specifies the enforcement obligations of MSs. [Ett00].

1.4 The Needs for and the Timeliness of the Study

The necessity for effective and adequate market surveillance has been acknowledged in many contexts and by all parties concerned. However, very little scientific research on the functionality and efficiency of market surveillance has been carried out.

Annually in Finland, about 2 M€ and the resources of 11 personnel have been applied to the market surveillance of electric products. Internationally this can be considered quite a notable investment for a small country. Nevertheless, there is still no investigated information as to whether the conformity level of today's electrical equipment is sufficient or even more than sufficient, i.e. "too good", which would mean that resources might even be wasted. Neither has it been established through investigation, how effectively resources have been utilized.

One of the MJVP's final remarks was that very little statistical data from market surveillance was available. In Finland, the obligatory pre-approval system for electrical equipment ended in 1994 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, TUVA database[viii], which today contains information on over 10,000 cases. The extent of the TUVA database is internationally considered unparalleled.

In the future, European enforcement collaboration presents huge challenges, and the frontiers of cooperation between market surveillance officials must be extended. In different EEA countries, market surveillance has been carried out in different ways. Also, new countries from Central and Eastern Europe with different enforcement histories are becoming part of the new EU. For these reasons, it is no surprise that more and more voices in the regulatory community have been requesting the development of unambiguous rules for market surveillance [Ett00]. The increasing inevitable globalisation of trade is also a real challenge for the enforcement community. Global trade brings global challenges and the opportunities that are created for consumers are accompanied

[vii] Available in all official EU languages at http://europa.eu.int/comm/enterprise/newapproach/legislation/guide/legislation.htm.

[viii] (fi.) Turvatekniikan keskuksen **tu**ote**va**lvontatietokanta (TUVA-tietokanta), (engl.) The Safety Technology Authority's product consistency enforcement database.

by ever present risks both to human health and welfare and also to legitimate businesses whose work may be put at risk by the activities of rogue operators. Products may be banned in the USA one day and appear for sale in Europe the next. “There is an urgent need to ensure that the community of enforcement around the world establishes the protocols and communication mechanisms to prevent the globalisation of trade presenting unacceptable risks to consumers and legitimate businesses.ī ī Future development must envisage a less insular approach to regulation and a much closer relationship between enforcement agencies. Global harmonisation of information systems and the mechanisms and methods of enforcement will be necessary if globalisation of trade is to sustain consumer confidence”, [Hun02]. As a result of these challenges, many steps have been taken to ensure that NA enforcement will become more effective and consistent. Also, many improvements, essential to the success of the NA, are ongoing [Ett00]. The analysis of the extensive Finnish market surveillance data of electrical products and, especially, the general conclusions drawn from it, could most certainly be applied when improving the market surveillance system in Europe.

A definitive research project on the market surveillance of electrical devices is most appropriate at this time - on 100th anniversary of Finnish electrical safety legislation - because:

1) The NA directives have been in use for more than 17 years in Europe and the LVD has been with us for almost 30 years, since 1973. But unfortunately, very little research work about market surveillance has been done during this period. Now would be an interesting time to look back at about 17 years of NA experience and see the role of market surveillance in this context. Presently, the EU is assessing the total NA principle.
2) Finland has been a member of the EEA since 1994; over 8 years. The Finnish market surveillance system for electrical equipment is the same age. In fact, after about 5 years experience the functionality of the new system would then have been possible to assess.
3) The directives covering electrical products are in the process of being renewed. At this point, it might still be possible to influence the content of the new version of the directives. In addition to the content of the directives, it would be important to analyze the way in which the directives are adopted by each country’s relative national legislation.
4) With eastern expansion of the EU, the legislation of candidate countries will be rewritten so as to be in accordance with the NA directives. Also, the enforcement that directives require will be commenced. This research should be an indicator as to the directions for the development of market surveillance systems in Europe and should be considered an open door opportunity for further research and development of market surveillance regulations, standards and monitoring methodology.

2. Scope and structure of the study

2.1 Scope and objectives

The scope of the study is to examine:

- the functionality of Finnish market surveillance for electrical equipment and accessories;
- the effects and main results of Finnish market surveillance on electrical equipment and accessories; and
- the methods of Finnish manufacturers and importers of electrical equipment and accessories with regard to safety and conformity operations, as well as their expectations and opinions concerning the market surveillance mechanism in place today.

The principles of modern authority supervision are described in GPSD, [EC99] and [Ahv00]. On the basis of these references, the following seven main principles for 'good' market surveillance are applied in this study:

1) Proportionality to the risk; the costs of supervision must be optimized in proportion to the risk.
2) Objectivity and consistency; when levels of risk are equal, then the levels of supervision should be the same.
3) The degree of accuracy; focusing on the common identifiable factors of risk.
4) Based on technical facts; assessment facts can be considered trustworthy and reliable.
5) Openness and transparency; all parties concerned must be made aware of their obligations and rights.
6) Credibility; supervisors must have resources and the given authority to apply methods of compulsion.
7) International compatibility and cultural reality.

This empirical study concentrates on asking and answering the following questions:

- **Question 1:** Does today's legislation relating to electrical equipment and accessories, and the technical standards supporting it, ensure that these products have conformity and are safe?
- **Question 2:** Does the Finnish market surveillance of electrical equipment and accessories operate appropriately, and does this surveillance fulfil the principles of modern authority supervision?
- **Question 3:** If the answer to the Question 1 or 2 is negative, how should the legislation and/or market surveillance structure be changed to support the needs of citizens and business?

The main objectives of this study are

- to initiate an estimation and analysis of the activeness and efficiency of the market surveillance of electrical equipment and accessories as carried out by TUKES;

- to develop TUKES's systems and methods of market surveillance and to improve their efficiency;
- to promote the impartial treatment of enterprises;
- to produce material for the development of legislation and technical requirements (standards) relating to product safety and environmental compatibility;
- to produce material for the development of legislation relating market surveillance; on a national and an international level;
- to produce a basis which could be utilized when TUKES takes on the challenges it will meet in the near and distant future; and
- to produce material which other Finnish[ix] and international market surveillance authorities could utilize when improving their systems and methods.

2.2 Structure and schedule

Preparation of this study commenced in 1997. The accumulation of research material was done in connection with a part of TUKES's basic operations; [1)] surveillance, [2)] communications and [3)] research and development. The market surveillance projects studied for the purposes of this work were carried out over the period 1997-2002. The interviews which charted the operation methods of importers were carried out in the first part of 2000. A telephone survey which outlined manufactures' and importers' expectations and opinions was undertaken in the autumn of 2001. The statistical analyses of market surveillance material as well as the analysis using The European Foundation for Quality Management (EFQM) model were carried out in 2001-2002.

The different stages of this research are shown in Fig. 2.1; also other projects which are closely related to this study are mentioned in the description model. The preceding TUKES's projects which provided background information for the whole study were the evaluation of market surveillance of electrical products [San98] and a study of the first ten years of the EMC directive in Finland [Raj00a]. TUKES's application for the quality award, 2001 [Tuo01] gave background information for publication [P1] and interview surveys [Rus00] and [Mau01] for publications [P2] – [P3]. TUKES's projects which supported this study were the electrical fire risk management study [Nur01], and selected safety culture studies [Ruu98], [Saa99], [Ruu00], [Saa00] and [Saa01].

At the beginning of the work the literature framework is described. It is divided into two parts; [1)] product requirements in Chapter 3 and [2)] market surveillance theories and international study results in Chapter 4. Chapter 5 presents the research material and methods used in this dissertation. Chapter 6 carries the summaries of the publications from which this dissertation is constructed.

[ix] All Finnish market surveillance authorities are described in [VAA02].

Publications are divided into four categories. In Section 6.1, publication [P1], which gives the overview of market surveillance of electrical equipment in Finland, is summarized. In Section 6.2 publications [P2] and [P3] are summarized. These publications deal with manufacturers' and importers' operation methods and their opinions on the existing authority mechanism and TUKES' methods. The main market surveillance projects undertaken by TUKES, are described in publications [P4]-[P7], and are summarized in Section 6.3. Publications [P8]-[P9], summarized in Section 6.4, analyse statistically the TUVA database for electrical products in Finland. Discussion related to the results of publications [P1]-[P9] and theories, principles and the results of earlier pieces of research are considered in Chapter 7, as well as major conclusions concerning the work and proposals for further suggested actions and activities.

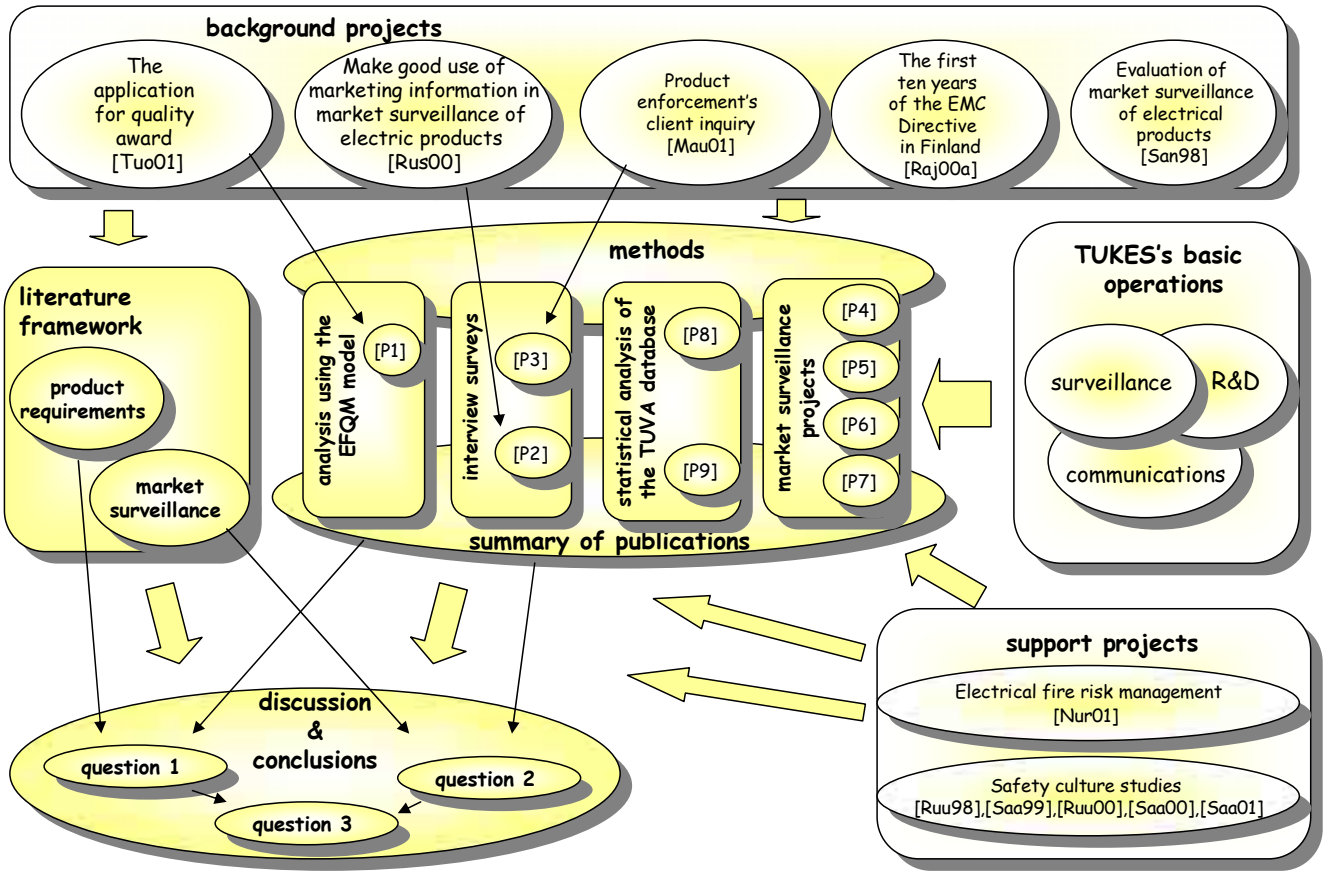

Fig. 2.1 The construction of the study; its three main components, background and supporting projects and the links to each other and TUKES's basic operations.

2.3 Contribution of the Author

Publication [P1] is based on the Author's 22 month's work as a development and quality expert in TUKES's product enforcement. The content of the work is based on [1)] TUKES's application for quality award in year 2001, [2)] the report which the quality award auditing group sent to TUKES after their auditing visit, and [3)] processing of the auditing feedbacks in leaders' self-assessment. Author was the *Product enforcement* department's main member in the TUKES's quality award project, he has written most parts of the publication and his contribution to the publication is 60 %.

Publication [P2] is based on the interviews carried out by Ms. Merja Rusanen and her preliminary analysis [Rus00]. The preliminary analysis was, however, guided and commented by the author. Nevertheless, the author has listened the tapes were interviews were recorded, and the new observations and analysis point of view presented in [P2] are originated from the author. The author's contribution to the publication is 50 %.

Publication [P3] is based on [1)] the analysis of TUVA database (made by author) to select interviewed persons and [2)] data of interviews carried out by Taloustutkimus Ltd. [Mau01]. The data was supplied to author by the SPSS 10.1 for Windows format. Author removed other than electrical equipment cases and made the analysis and observations and conclusions.

Publications [P4]-[P7] are based on TUKES's EMC market surveillance projects. The author was the line manager of 3 first projects and the 4th project was carried out under the supervision by the author. The author wrote fully the publications [P4] and [P5]. With regard to the publications [P6] and [P7], Mr. Arto Kasanen assisted the work but the author had the main responsibility. With regard to the publication [P6], Mr. Magnus Axelsson supplied the data from Swedish test results and he assisted with the part that refers to Swedish results. The author's contribution to these publications ranges from 100 % in [P4] and [P5] to 80 % in [P6] and [P7].

The publication [P8] and [P9] are totally written by the author. Mr. Tommi Laanti made the preliminary analysis for publication [P9] under the supervision by the author. The author's contribution to this publication is 80 %.

The public presentations of the publications in relevant conferences have been made by the author. The co-authors have seen these descriptions of contributions, and agree with the author.

3. European requirements for electrical products

3.1 European product requirements in general

Many different stipulations and requirements have been placed on the products, which are sold in the European Economic Area. They can be concerned with features, markings, packing and packaging and manufacturing as well as information and instructions for products. Also, testing, inspection and certification of products may be required. The purpose of these stipulations and requirements is to protect the health and safety of human and domestic animals, the environment and general consumer protection.

In Europe, the unification process of different countries and the development of The European Union have been underway for a long time. One of the main objects of European integration is the realization of the common internal market so as to reinforce economic growth. The principal aim has been to dissipate barriers to trade between Member States. The free movement of goods and the removal of technical barriers to trade are key elements of the EU's single-market program and the European system with regard to conformity assessment. In a single European market, goods should be able to cross borders without national re-inspection or retesting [Ett00], [Fis00]. The removal of technical barriers to trading is achieved through [1)] the harmonisation or [2)] mutual recognition of requirements [EC99].

The harmonisation of requirements in the EEA is mostly done by way of *directives*, but *regulations* and *decisions* are also applied. Regulations are binding and they are directly enforced in all Member States [FIN99]. Decisions, on the other hand, specifically apply to set bodies or the individuals to whom they are addressed; the Government of a MS or a private individual, within the compass of the decision's content [FIN99]. If a product has no European general legislation, then in principle, the MSs can independently set their own technical legislation. Neither the EU nor its MSs have set legal requirements for all products [Kaa00] and neither do they intend to.

A directive is a piece of binding legislation handed down to MSs from the Council of the EU known as the Council on Ministers. In the Council, the ministers of MSs meet in different compositions, depending on the subject or area to be discussed. The directives handed down bind MSs to following common rules, which most often means that MSs then have to change their legislation in accordance with a directive within a given time frame. A directive defines the aims of the regulation, but MSs are allowed to decide the means and ways they use to apply the new regulation. Today, more than 1450 directives are valid in the EEA [Kaa00].

Product directives are given on the basis of Article 95 of the Treaty establishing the European Community (the EC Treaty). These directives specify the framework that a product has to 'fit into'. MSs are not permitted to apply their own, possibly stricter rules, in preference to those defined as the maximum called for in the directive. When all parties concerned abide by product directives, the free movement of products is guaranteed within the EEA.

Health and safety at work directives have been established in Article 137 of the EC Treaty. These directives define the many various minimum requirements that have to be observed by production plants and their equivalents. Requirements may be environmental, they can protect the conditions and safety of employees, safeguard the consumer's legal rights, etc. National laws are allowed to be more stringent than the directives. These directives are intended to stop unhealthy competition at the cost of the environment, employee or any disadvantaging or harmful factor.

3.2 The New Approach and the Global Approach

The New Approach (NA) and the Global Approach (GA) are in detail delineated in the 'Blue Guide' [EC99]. The NA to a single European market was made public in 1985 in the White Book, which described a resolution that was adopted by the Council in 1985 for the development of a series of directives to govern the quality, testing, and inspection of products [Ett00]. These directives set out the essential requirements that ensure the protection of health and the environment. These requirements must be fulfilled before a product can be put on the European market.

The NA established the following four principles [EC99]: [1)] Legislative harmonisation is limited to essential requirements that products placed on the Community market must meet, if they are to benefit from free movement throughout the Community. [2)] The technical specifications of products meeting the essential requirements set out in the directives are laid down in harmonised standards. [3)] Application of harmonised or other standards remains voluntary, and the manufacturer may always apply other technical specifications to meet the requirements. [4)] Products manufactured in compliance with harmonised standards benefit from a presumption of conformity with the corresponding essential requirements.

Whereas NA directives only set out essential requirements and legal aspects, detailed technical specifications are drawn up by harmonised standards made by the European standardization bodies: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), and the European Telecommunication Standardization Institute (ETSI). Most of the European harmonised product standards are based on international standards; the standardization structure is shown in Table 3.1. The global standardization organisation in the

electrical and electronic fields is the International Electrotechnical Commission (IEC), in which The Finnish Electrotechnical Standards Association (SESKO) act as the Finnish national committee. At the end of 2001, IEC had 61 member countries and it had 4,820 validity standards, which contained all together 114,811 pages [SES02].

Table 3.1 Standardisation structure

	General	**Electrical engineering and electronics**	**Telecommunications**
International	ISO	IEC	ITU
Europe	CEN	CENELEC	ETSI
Finland	SFS	SESKO	FICORA

Fig. 3.1 illustrates the relationship between NA directives and harmonised standards. Compliance with these standards is voluntary, although a product manufactured in accordance with them is presumed to fulfil the basic requirements and will enjoy free movement throughout the EU. The presumption of fulfilment is a great privilege given to standards in Europe and standardization operations should function appropriately with regard to this responsibility. The manufacturer may choose not to comply with the harmonised standards, but must still be able to show that the product fulfils the essential requirements of the applicable directives. For product types that do not have harmonised specifications, mutual recognition of test, inspection, and certification results based on the EN 45000 series of standards can be applied [Ett00].

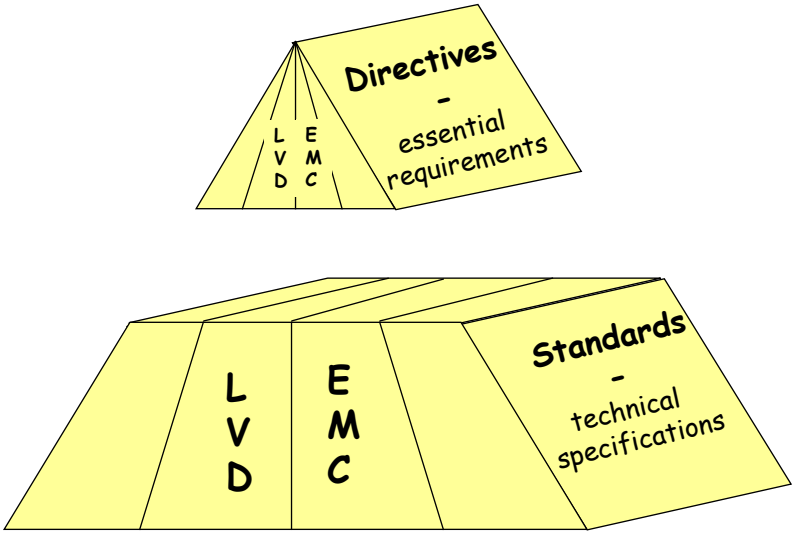

Fig. 3.1 The relationship between the NA Directives and harmonised standards [x].

[x] Modified from [SET93].

The directives also indicate to what extent the manufacturer must arrange for products to be tested or inspected by a competent third party. The Global Approach lays down general guidelines and detailed procedures, 'modules', for conformity assessment that are to be used in NA directives. Thus, conformity assessment is based on [xi]: 1) a manufacturer's internal design and production control activities; 2) third party type examination combined with a manufacturer's internal production control activities; 3) third party type or design examination combined with third party type approval of product or production quality assurance systems, or third party product verification; 4) third party unit verification of design and production; or 5) third party approval of full quality assurance systems. The simplest method for demonstrating that a product fulfils the essential requirements is a supplier's declaration, a statement from the manufacturer that a product or service was made in accordance with requirements (module 'A'). Along with this statement, a technical file for the purpose of market surveillance is also often required. For potentially dangerous products, however, the declaration is often not sufficient and third-party involvement is required. Fig. 3.2 gives a comparative overview of the contents of the modules 'A'-'H'.

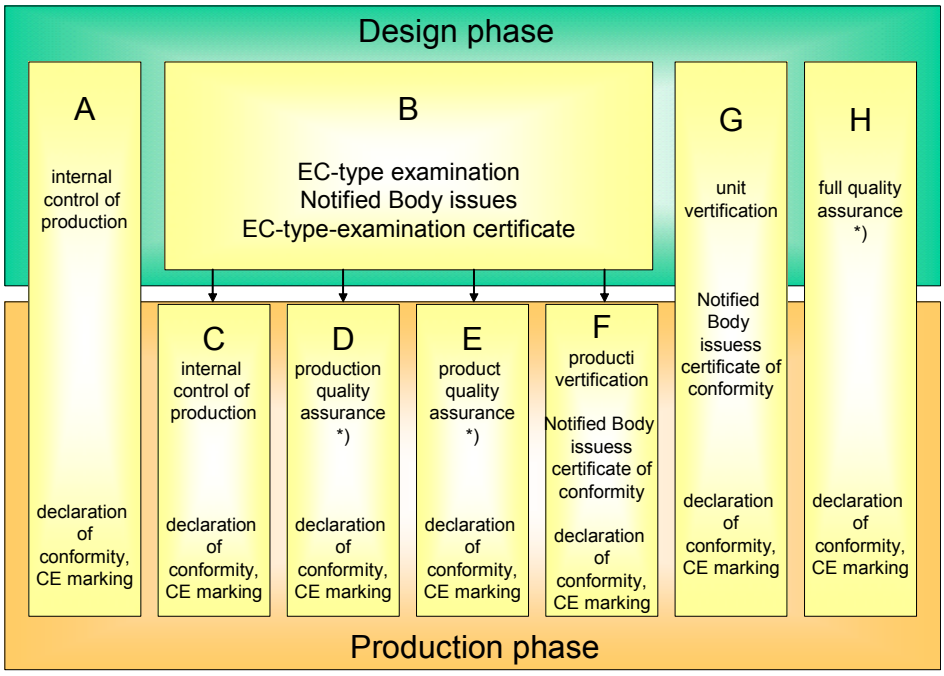

Fig. 3.2 The conformity assessment procedures and their division into the product design and production phases [Koh95], [EC99].

[xi] Council Decision 90/683/EEC which was replaced and brought up to date by Decision 93/465/EEC.

3.2.1 CE marking and EC declaration of conformity

The CE marking, the external symbol that a product fulfils the applicable requirements of directives, was adopted in 1993 [xii]. CE marking symbolises the conformity of the product with the applicable Community requirements imposed on the manufacturer. The CE marking affixed to a product is a declaration by the person responsible that 1) the product conforms to all applicable Community provisions, and 2) the appropriate conformity assessment procedures have been completed. The 'Blue Guide' describes among other things the principles of CE marking, products to be CE marked, the affixing of the CE mark and the relativity of CE marking to other marks.

NA directives impose an obligation on the manufacturer, or on the authorised representative established within the Community, to draw up an EC Declaration of Conformity (DoC) as a part of the conformity assessment procedure. The DoC should contain all relevant information to identify the directives according to which it is issued. It should also contain information about manufacturer, the authorised representative, the notified body if applicable, the product, and where appropriate, a reference to harmonised standards or other normative documents. The contents of the DoC, as well as the period for which it should be available to authorities, are separately laid down in each directive. The retention period is most commonly ten years from the last date of the manufacture of the product.

3.2.2 Certification marks

Electrical equipment may also bear other marks showing its conformity with standards mainly as provided for by the LVD. These certification marks are symbols of independent testing laboratories and they fulfil a different function than those of CE marking. These other marks should not in any way cause confusion with CE marking and should not reduce its legibility and visibility.

Use of certification marks is voluntary. Exceptions are plugs and socket-outlets intended for household use, which may be subject to a mandatory certificate issued by a competent testing body operating in the EEA. In Finland, the mandatory certificate should be based on a standard used in Finland, and should therefore be acquired by the importer or Finnish manufacturer.

[xii] Council Decision 93/465/EEC of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures and the rules for the affixing and use of the CE conformity marking, which are intended to be used in the technical harmonisation directives.

3.3 Legal requirements for electrical products

3.3.1 The Low Voltage Directive

The Low Voltage Directive (LVD) covers electrical low-voltage products and components. This directive applies to AC electricity in the voltage ranges from 50 to 1000 V or DC in the voltage ranges from 75 to 1500 V, for electrical appliances that perform within these voltage ranges. As with all EC product directives, the LVD has the prime intention of improving the free movement of goods within the European internal market area. The amendment to the LVD, 93/68/EEC, also encompasses CE-markings. CE marking in the EEA, according to the LVD, became necessary at the beginning of 1997 when the transitional period for the LVD ended. The latest LVD Guide [xiii] was updated in February 2001 and is available via the Internet.

The LVD was created several years prior to when the EEC decided on new procedures in technical harmonization, now known as the New Approach and the Global Approach. However, the LVD propitiously fulfils the elements of the NA, and as such, contains only the essential requirements, where, on the other hand, technical requirements are set by different standards.

The LVD covers more harmonised standards than any other directive. In the Official Journal of the EC, more than 500 harmonised standards are mentioned as being in harmony with this directive as of November 1999 [Kaa00]. Three of the main standards included in the LVD are those directed to information technology appliances and electrical office machines EN 60950-1[xiv], the general standard for domestic appliances EN 60335-1[xv] and the general standard for low voltage switchgears EN 60439-1[xvi] [Kaa00]. In addition, the standard for luminaries EN 60598-1[xvii] is widely used. Harmonised standards with regard to the safety of electrical equipment are considered to fulfil the essential requirements of the directive. The fulfilment of the demands for conformity is considered to have been met with the manufacturer's own guarantee declaration of conformity.

For the purposes of authority inspection, CE-marked electrical equipment shall be covered by available technical documentation. As provided for by the Low Voltage Directive, the documentation shall comprise the following information: [1)] a general description of the equipment; [2)] conceptual design and manufacturing drawings, and schematic drawing of components, sub-assemblies, circuits etc; [3)] descriptions and explanations necessary for the understanding of said

[xiii] Guidelines on the application of Directive 73/23/EEC, (Electrical equipment designed for use within certain voltage limits), February 2001. http://europa.eu.int/comm/enterprise/electr_equipment/lv/guides/index.htm.
[xiv] EN 60950-1:2001 "Information technology equipment – Safety – Part 1: General requirements".
[xv] EN 60335-1:1994 "Safety of household and similar electrical appliances – Part 1: General requirements".
[xvi] EN 60439-1:1999 "Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies".
[xvii] EN60598-1:2000 " Luminaires – Part 1: General requirements and tests".

drawings and schematic drawings and of the functioning of the equipment; [4)] a list of the standards applied in full or in part, and descriptions of the solutions adopted where standards were not applied; [5)] results of design calculations and examinations; [6)] test reports; and [7)] a copy of the declaration of conformity. The manufacturer or an authorized agent is responsible for making documentation available in the EU area. It is provided for in the LVD that the manufacturer shall use an appropriate quality control system to ascertain that each product manufactured is in conformity with the directive and technical documentation.

Today, the renewal of the LVD is in progress.

3.3.2 The EMC Directive

Electromagnetic compatibility (EMC) means the ability of a device, unit of equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything within that environment. In Europe, the EMC Directive (EMCD) defines requirements for the EMC of electrical appliances. The main goals of the EMCD's essential requirements are: [1)] to ensure that the electromagnetic disturbances produced by electrical and electronic apparatus do not affect the correct functioning of other apparatus as well as radio and telecommunications networks, related equipment and electricity distribution networks; and [2)] to ensure that the apparatus has an adequate level of intrinsic immunity to electromagnetic disturbances to enable it to operate as intended. So, European EMC requirements cover emissions as well as immunity.

In showing compliance with that directive manufacturers must demonstrate that their equipment meets protection requirements. Legally, there are three ways to demonstrate compliance, and these are as follows: [1)] self certification through harmonised standards, or [2)] compilation of a Technical Construction File (TCF) which must contain a report or certification from a third party – a so-called Competent Body, or [3)] if the product contains a radio transmitter, then a specific type approval is required. The TCF is required if harmonised EMC standards are not applied fully. After the adoption of the Radio and Teleterminal Equipment Directive (R&TTED)[xviii], that type approval mode is applicable only for equipment intended to be used at civil aviation land based stations.

The EMCD set out in 1989, came into effect in 1992 and from 1996 the application of the directive has been mandatory. Although the time taken from the directive being drawn up to its obligatory application was six and half years, the requirements of the directive came as a surprise

[xviii] Council Directive 99/5/EC of the European Parliament and of the Council relating to radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

for many manufacturers. Even today, not all manufacturers and importers know the extent of their own responsibilities.

Although the EMCD consists of only seven pages, it has proven to be one of the most disputed new EU-laws. In responding to criticism and uncertainty, The Commission has published several guidelines for directives. The last EMCD Guide [DGI97] was made in 1997 and it contains 124 pages including appendixes. Still, this Guide needs back-up from the 'Blue Guide', which clarifies responsibilities, etc. Today, the renewal of the EMCD has been in progress for several years. The renewed EMCD should be accepted in 2003.

3.3.3 The R&TTE Directive

The transfer time for moving into the new R&TTED was completed on 8.4.2000. Following this, radio and teleterminal equipment is allowed to be brought onto the market in the normal way just based on a declaration from the manufacturer. For radio equipment there is, in certain cases, a requirement for a testing program to be made by a Notified Body (NB) and also for an assessment of test results. For the use of some radio equipment, a licence from the Member State where the product is intended for use is still required [Jok00].

The R&TTED covers all teleterminal equipment and almost all radio equipment. Not included in the scope of the directive are broadcast receivers, radio equipment made by radio amateurs themselves, the obligatory radio equipment of ships and also radio equipment for air-vessels.

The biggest difference between the R&TTED and the earlier directive is that, instead of acceptances of authorities, the manufacturers' self-declaration system is being applied. The amount of documentary information required for equipment is likely to increase considerably. With regard to radio transmitters, there must be information about possible restrictions on use, e.g. if use is subject to license, or the use of the transmitter's specific wave range is not permitted in certain countries. All restrictions on use have to be noted with 'a notice mark', which is an exclamation mark within a circle. [KOD00].

One thing which remains unchanged is that all pieces of equipment must conform. The R&TTED does neither bring changes in matters concerning licenses nor in any possible examinations required of users [KOD00].

The CE mark is sufficient for pieces of wire network equipment and for radio receivers. Besides requiring the CE mark, radio transmitters also need to have the identification number of the NB which has dealt with the certification of conformity for the product in question. This is in cases where a NB is needed. Also the attention mark is required where there might be possible restrictions of use. In Finland, radio transmitters which are made according to the R&TTED are exempted from

requiring a license and neither do they need an acceptance mark from The Finnish Communications Regulatory Authority (FICORA) [KOD00].

3.3.4 Other Legal Requirements for Electrical Products

Essential requirements set up by NA directives may overlap or complement each other, depending on the hazards that are related to the product in question. Placing on the market and putting into service can only take place when the product complies with the provisions of all applicable directives, and when conformity assessment has been carried out in accordance with all applicable directives. Where two or more directives cover the same product or hazard, the application of other directives can sometimes be excluded following an approach that includes a risk analysis of the product with a view to its intended use as defined by the manufacturer. For example, electrical products subject to other NA directives, e.g. the Directive on Simple Pressure Vessels, must comply with all relevant directives before they can be CE-marked. A complete presentation of NA directives can be found in Annex 1 of the Blue Guide [EC99].

On the other hand, the LVD and EMCD do not apply to, for example, electrical equipment for medical purposes. Instead the directive relating to medical devices, active implantable medical devices or *In vitro* diagnostic medical devices may apply.

Also requirements other than NA directives cover electrical equipment. For example, refrigerators, freezers and combinations of them, washing machines, tumble dryers and their combinations, dishwashers and domestic lamps must have an energy consumption marking. The technical trade description of these ‘white products’ must be available at the shop of purchase. Based on this, the consumer can decide which unit of equipment is most suitable for his/her needs.

3.4 Future requirements for electrical equipment

3.4.1 The reviewing of directives regarding electrical equipment

Reviews and revisions of the R&TTED, EMCD and LVD are in progress today, the EMCD is the most advanced at this stage. A technical study [EXC00] contained support material for the revision of the EMCD. Another study [RPA02] was conducted to assess the overall level of costs and benefits from the enforcement of the draft amendment of the EMC Directive. Data on the potential impacts of the amendment, and the costs and benefits associated with these effects, were drawn from a search of literature and consultation with more than 400 organizations, companies, and individuals potentially affected by the amendment. Results of the study are summarised in [Fen02].

The ongoing parallel reviews and revisions have shown a need for the improved coordination of the R&TTED, EMCD and LVD. The main reason for this is due to developments in the telecom

and IT industries. In the near future an increasing number of electrical products will include built-in radio equipment. In order to avoid electromagnetic disturbances and to make it easier for the manufacturer to comply with all relevant directives, the opportunity to improve the coordination of these directives should be seriously considered.

At the present time the European Commission is preparing [1)] a revision of the LVD, dealing with the safety of electrical products; [2)] a revision of the EMCD, dealing with electromagnetic compatibility of electrical and electronic apparatus; and [3)] a review of the R&TTED, dealing with radio equipment and telecommunications terminal equipment. These three administrative activities are being carried out independently and over different periods so, there has been very little considerations of the technical interrelationships between these directives and a good opportunity for optimisation through the restructuring of their scopes and contents is possibly being missed. These three directives where originally developed [1)] in different areas of the Commission; [2)] at different phases of development of the internal market; and [3)] to satisfy the particular regulatory objectives of Member States which were valid at the time of the development of the directives.

These directives are generally considered to be good examples of well-functioning NA directives. It is however apparent that [1)] developments in technology; [2)] the fulfilment of certain objectives related to the completion of the internal market; and [3)] a tendency to greater reliance on other aspects of Community Legislation to ensure a well functioning market place, including consumer protection, have led to a situation where a more strategic overview of the purview and applications of these three directives is desirable.

For the purposes of this section, a directive spanning many sectors in its application is termed horizontal, and a directive specific to one sector is termed vertical. The LVD is a horizontal directive, covering safety and user health for a wide range of products with regard to hazards arising from the equipment itself and hazards due to external influences. The EMCD is a horizontal directive covering a wide range of products and with essential requirements covering [1)] the limitation of emissions in order to protect the radio spectrum; [2)] the limitation of emissions in order to protect the functioning of telecommunications and other apparatus; and [3)] immunity to electromagnetic disturbances (where radio sources are major culprits). The R&TTED is a horizontal directive with regards to radio matters and a vertical directive with regards to telecommunications terminal equipment.

The essential requirements of the EMCD are repeated in the R&TTED. The safety objectives of the LVD are repeated in the R&TTED. The R&TTED also includes an essential requirement covering the effective use of the radio spectrum, which is applicable to equipment containing a radio transmitter.

3.4.2 Scenarios for the directives of electrical equipment

This chapter is based on recent discussions between experts from the Commission and Member States.

The EMC and R&TTE Directives share one common purpose in the protection of existing and planned radio services. The implementation of radio functionalities in a wide and increasing range of equipment is a well-established technological trend. Furthermore, an increasing number of functionalities and services are being implemented through radio solutions. Because of the increasing application of radio solutions the interdependence of theses two directives is being reinforced. It is therefore advantageous for the legal basis of protection requirements to be harmonised. One advantage of a combined basis would be an increased understanding at all the relevant levels, including standardisation, as to how radio services can be protected and utilised in an optimised way. Both directives share a second common purpose in ensuring that the products covered by each directive have adequate immunity to electromagnetic disturbances.

The R&TTED and the LVD share a common purpose with regards to safety and health aspects. There is not, however, the same degree of similarity between the other objectives of the LVD and the other two directives.

The vertical aspects of the R&TTED deal primarily with telecommunications terminal equipment and operator specific requirements. It would be possible to incorporate the operator specific requirements into already existing or planned directives directed towards operators in the electronic communications sector and it can be argued that such incorporation would lead to a rationalisation of the present situation. For the remaining terminal equipment related aspects, where these are still required, a suitable legal framework based on the NA principle should be sought.

Based on the preceding brief discussion the following restructuring is proposed by Sweden[xix]: [1)] An extended EMC directive should be developed, which should also cover all radio aspects with essential requirements applicable to all equipment within the present scopes of the EMC and R&TTE Directives. [2)] A revised “Low-voltage” Directive should be developed that is extended to cover voltages down to an agreed limit which is lower than specified in Directive 73/23/EEC and to cover all the safety and health requirements stipulated by the Low Voltage and R&TTE Directives today. [3)] The operator related aspects of the R&TTED should be transferred, where appropriate, to other directives in the electronic communications sector. The remaining terminal equipment-specific aspects, if still required, should be placed in a suitable legal framework based on the principles of the NA. [4)] The provisions relating to the market surveillance of the new directives

[xix] A letter “Coordination of directives affecting electrical products with inbuilt radioequipment”, 2001-11-20, from Mr. Ingvar Enqvist, Swedish National Electrical Safety Board, to Mr Fernandez-Ruiz, European Commission.

should be harmonised to ensure the traceability of manufacturers and representatives both inside and outside the territories of the EU.

3.4.3 Challenges in technical requirements

The minimum level of technical requirements for electrical products is given through harmonised standards (both LVD and EMCD). The largest and most recognisable product safety problems are associated with electricity, either because of [1)] electric shock hazard, [2)] fire hazard, or because [3)] mechanical movements generated via electromechanical devices can be dangerous. Both the LVD and the Machinery Directive (MD)[xx] require that products under their scope must be safe in all respects. The harmonised standards of these directives cover points [1)] and [3)] but fire hazards are still an outstanding problem for some product types [Nur01].

Safety and EMC standards have traditionally been based on an industry tied product basis. For example, the Personal Computer (PC) that is also a TV can be considered as being within the scope of several different standards. The requirements of information technology (IT) equipment and consumer electronics are uniting, in both electrical safety and EMC fields.

The widespread use of mobile phones has increased the awareness of the need to address the issue of EMC and functional safety. EMC means that a device continues to function correctly when a particular EMC test is applied. Such tests only inform you that its performance is acceptable in a particular situation. The key issue is what happens to the product in a more onerous situation: will it fail in a safe state, or does something more serious, such as a fire, occur? One of the key factors in the area of functional safety is where and how the product is used, and such factors are not always within the manufacturer's control. To assist industry in this area, the IEC have recently issued a new technical specification IEC 61000-1-2 [xxi], whilst CENELEC has produced a guide R0BT-004[xxii] [Ker02]. EMC and functional safety is not an issue covered by the EMCD [Boe02]. These requirements from existing EMC product standards are being transferred under the LVD and new standards concerning EMC and functional safety will be harmonised under the LVD.

New challenges concerning purely EMC aspects can be broadly divided into four main areas as follows:

- EMC problem areas; e.g. thermostat interference, lighting interference, magnetron emissions, low power radio receivers, emissions from power drives [Ker02], [Ver02].

[xx] Directive 98/37/EC of the European Parliament and of the Council of 22 June 1998 on the approximation of the laws of the Member States relating to machinery. Amendment 98/79/EC.

[xxi] IEC TC 61000-1-2:2001 "Basic EMC Publication – Part 1-2, General – Methodology for the achievement of the functional safety of electrical and electronic equipment with regard to electromagnetic phenomena".

[xxii] ROBT-004:2001 *(CLC/BTWG 99-2)* "EC Directives, functional safety and the role of CENELEC standardization".

- New EMC issues; e.g. broadband emissions, electric vehicles, digital immunity, selective screening [Ker02].
- Network EMC; e.g. digital power line communications [Ker02], [Ver02], [Han02].
- Higher frequencies; e.g. measuring methods above 1 GHz [Ker02].

3.5 Functionality of the New Approach and the Global Approach

The New Approach is avowed to be a useful tool for the construction of the internal European market. It overcomes difficulties involved in previous legislative approaches, such as the very slow adoption of changes in legislation, constraints on manufacturers, and difficulties in adapting to technical progress. The NA is an approach which: [1)] covers wide fields of product or risk in a single directive; [2)] defines generic requirements which do not require frequent updating and do not therefore risk being outdated as was in the Old Approach legislation (lengthy adoption/revision process); [3)] limits government intervention to only what is essential, while leaving technical solutions to the specialists; [4)] encourages industrial innovation and competition and thus offers manufacturers scope for alternatives and choices as to how to comply with 'essential requirements'. In trying to establish both well-defined policy objectives and the conditions for their flexible and cost-effective implementation, the NA represents a classic example of 'co-regulation'; target-oriented legislation; the integrated approach. [Coz00].

Standards play an important role in the NA. Standards can also maintain and even lead to higher levels of consumer protection. According to consumer organisations, the harmonisation of standards in Europe has been a positive development; the use of standards can provide solutions and respond to emerging hazards more quickly than the more formal regulatory process [Far02]. "Standards can help stimulate the spread of best practice through providing an international forum for the exchange of relevant experience. The standardisation process is - - more open to the direct participation of the concerned stakeholders themselves", [Far02]. However, certain safeguards are needed to ensure that standards do in fact reflect genuine consumer needs [Far02]: "First and foremost there needs to be adequate representation of non-industrial interests on standards committees. This can be through representatives from consumer organisations and from safety institutes and other organisations who have the relevant expertise to ensure that priority issues from the consumer safety perspective are tackled." (With regard to this statement, TUKES has recently invested more in the standardisation work of the IEC Technical Committee (TC) 61[xxiii] and TC

[xxiii] IEC TC 61 "Safety of household and similar electronic appliances".

108[xxiv].) Also, links between standards and other components of the consumer safety infrastructure should be established; e.g. market and injury surveillance can identify priorities in the standardisations programme [Far02]. "Research and testing programmes should be directed by the results of enforcement and injury data and should provide solutions to be implemented in new and revised standards. [One example, based on TUKES's research into the temperature increases on the accessible front and side surfaces of cooking ranges[xxv], the Finnish national committee proposed to IEC to amend the relevant standard.] Safety promotion programmes need to be coordinated with standards as education and information can be vital to the successful application of a new standard in practice", [Far02]. However, the limitations of the standardisation process must be acknowledged and the right for authorities to regulate must be retained [Far02]. Safeguard clause procedures of NA directives when shortcomings are recognised in harmonised standards, e.g. Article 9 in the LVD, represents this kind of 'right' for MSs. It has also been applied in practice; e.g. the 'toaster case' in which the harmonised standard EN 60335-2-9 [xxvi] was found not to necessarily guarantee full compliance with the LVD because of the hazards in connection with non-working surface temperatures [xxvii]. This forced CENELEC to react and contributed to the amending of the standard.

Industry supports the principle of the NA and the GA, especially the module 'A' based on the Suppliers Declaration of Conformity (SDoC) with regard to meeting standards and regulations; and as such, third party certification should not be mandatory but be used on a voluntary basis as appropriate. Unsafe products, brought to the market by criminally negligent manufacturers who also falsely use SDoC as certificates, undermine the credibility of both types of conformity declaration. Industry sees also that market surveillance is as an exceptionally important tool. Industry's goal and dictum for conformity assessment is 'tested once, accepted everywhere', for now and the future. This should also be the principle for effective market surveillance. Penalties for unsafe products through the misuse of markings could serve as a source for funding market surveillance. [Fis00].

[xxiv] IEC TC 108 "Safety of electronic equipment with the field of audio/video, information technology and communication technology".

[xxv] More information can be found from TUKES release 18.4.2001 "Sähköliesien pintalämpötilat vaatimusten mukaisia" (In Finnish) which is available via TUKES's Internet pages.

[xxvi] EN 60335-2-9 "Safety of household and similar appliances – Part 2: Particular requirements for toasters, grills, roasters and similar appliances."

[xxvii] Commission opinion of 30 March 2000 with the framework of Council Directive 73/23/EEC relating to electrical equipment designed for use within certain voltage limits (OJEC 2000/C104/07, 12.4.2000).

4. European Market Surveillance

4.1 Principles of the modern technical control system

The reason for having technical inspections and monitoring is to make certain that health, safety, reliability, compatibility and similar requirements are observed. A general principle is that responsibility for control is divided between both authorities and other participants, such as manufacturers, users and owners. In the regulated area, authority supervision is always in place [Ahv00]. In Finland, the jurisdiction of authorities is regulated by the weight of the legal Act. E.g. the Electrical Safety Act [xxviii] regulates ...'*Electrical Safety Authority' shall refer to the Safety Technology Authority;*...

There are many ways in which to classify the types and applications of technical control. An example of one is shown in Table 4.1. A classification that can be found in the production chain is suitable for the manufacture of products, and both, the NA and GA directives can apply to it [Ahv00]. Market surveillance, the method for enforcing the functioning of European conformity assessment systems, is based on requirements given in the NA and GA directives. The common principles of conformity assessment and market surveillance are shown in the 'Blue Guide'. The requirements for market surveillance are very general, leaving most of the practical details of surveillance methods to the discretion of the MSs [Ett00]. There are major differences between MSs and product categories and also in the way market surveillance is carried out. Some MSs do not have market surveillance organisations while others carry out passive market surveillance, reacting only after crises occur. Some MSs actively plan and execute the monitoring of product compliance but often the level of market surveillance varies very much between technical sectors, even in these 'active' MSs. In order to make market surveillance effective, authorities must have the necessary authority and power to carry out their surveillance activities.

The state and level of control after products have been marketed varies considerably in different technical sectors and in different countries. Harmonisation of control methods improves effectiveness and economics, although essential sectored elements have to be acknowledged, also cultural thinking towards authority and inspections must be taken into account when creating general prescriptions for better systems. Optimization of the amount of required work is important and to this purpose, a common assessment unit that includes authorities and entrepreneurs, is needed [Ahv00]. This assessment unit has a central role to play within the quality control system [Ahv00].

[xxviii] Electrical Safety Act (410/1996), Finland, 4§.

Table 4.1 The Structure and Components of Safety and Reliability Control [VAA02]

<table>
<tr><th colspan="5">Safety and reliability surveillance</th></tr>
<tr><td colspan="3">Product control
- products must fulfil requirements</td><td colspan="2">User, environment and environmental effects control
- companies
- work and environmental conditions
- usage and storage conditions</td></tr>
<tr><td colspan="2">Initial control
- conformity assessment before products are on the market</td><td>Market surveillance
- make sure that initial control works
- ensure the conformity of products on the market</td><td colspan="2"></td></tr>
<tr><td>Internal control
- manufacturer[xxix]</td><td>Authority control</td><td>Authority control</td><td>Internal control</td><td>Authority control</td></tr>
</table>

"Market surveillance should not merely be regarded as an obligation resulting from the EC rules, but also as a means of ensuring compliance with current regulations. In the nonharmonised area, it ought, therefore, to be the actual need for surveillance that is decisive rather than the fact that this area is not regulated at the EC level. In practice, it is the nonharmonised area where substantial efforts are needed", [Ett00].

In future, this control function must have answers ready to meet new challenges, such as the internationalisation of markets, expansion of world-wide production, product technological development, e-business, and new requirements for effectiveness. It has not yet been defined how regulation and control systems have to improve so that they can respond to these new challenges. From this standpoint, [Ahv00] can see today that opportunities exist in, for example, the lightening of legislation, increasing self-monitoring, international harmonization and standardization, international control, the intensification of national systems, the combination of both national and international cooperation between authorities, reciprocal identification, cost liability.

4.2 Market Surveillance in Relation to the New Approach Directives

The primary responsibility for safety and compliance with requirements for products, belongs to the manufacturer and importer. The official supervision, i.e. market surveillance, makes certain that

[xxix] The manufacturer could use the assistance of an assessment body (a 3rd party testing body).

regulations are observed and no dangerous or nonconforming products are on the market. When necessary the products that are contrary to requirements must be removed from the market. Market surveillance is of prime importance for the functioning of the European single market, because if consumers lose their trust in the safety and compliance of products on the market, the whole basis for believing in a single market risks disappearing and could mean a retrogressive return to national regulations and activities.

The CE marking has become one focal point of market surveillance strategies for MSs. However, since the CE marking was adopted in 1993, a lack of confidence in the EU conformity assessment structure has become a major issue [Ett00]. Many CE-marked product groups have failed to meet essential requirements and some CE-marked products have actually been shown to be dangerous; especially with regard to toys and equipment for children [Van00]. Also, some products on the market were sold without the CE mark. Another reason for lack of consumer confidence in the CE mark is the fact that the consumer is often unsure of the meaning behind the mark, especially when comparing it with commercial certification marks. So the SDoC procedure presents an enforcement challenge. If the market surveillance is not consistent and effective, businesses are placed at risk by low consumer confidence, and consumers are placed at risk by unsafe products. [Ett00].

4.3 Safeguard clause procedure and RAPEX

The New Approach directives include a form of safeguard clause, which contain obligations for member states to meet: [1)] To take all necessary steps to ensure that only compliant products are placed on the market, and [2)] to notify the Commission of any national measures that run counter to product declared conformity with the EU provisions and can be ascertained as liable to endanger health and/or safety. National decisions relating to product distribution restrictions must indicate whether non-compliance results from [1)] failure to meet the essential requirements, [2)] incorrect application of harmonised standards, or [3)] shortcomings in the harmonised standards themselves. Any risk relating to safety or health must be directly related to the product itself (intended use) and not its possible misuse.

Following a notification, the Commission enters into consultation with all parties concerned: [1)] the manufacturer or his authorised representative and the member state concerned, [2)] where appropriate, the notified body and the designating authority, and [3)] the notifying member state. If the Commission finds that the measure is justified it informs all member states, but if found unjustified then the Commission informs the notifying member state to withdraw the measure. The goals of the safeguard clause procedure are to ensure the free movement of goods and, at the same time, a high

level of protection [EC99]. All these components together mean a uniformly high level of enforcement of the European internal market legislation; market surveillance and administrative cooperation [Fáb00]. Fig. 4.1 shows the statistics per country over the last three years (1999-2001) with regard to safeguard clause cases according to the EMCD.

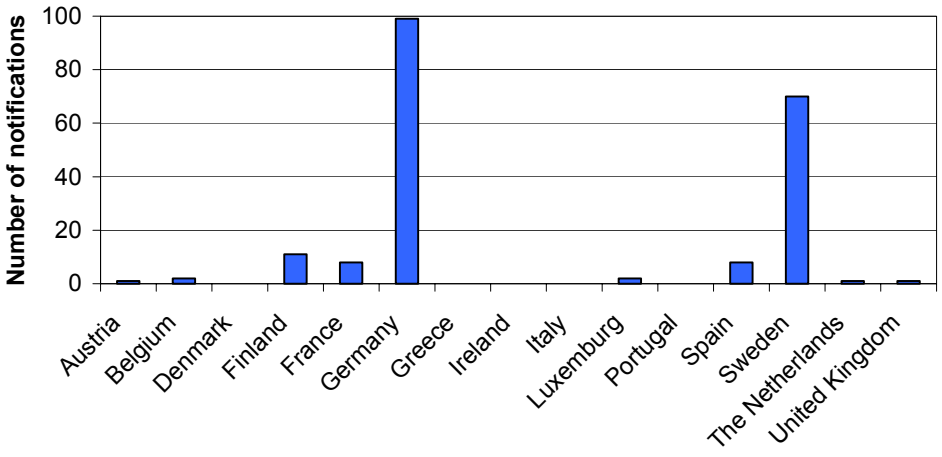

Fig. 4.1 The number of EMCD safeguard clauses per notifying country between 1999-2001.

The General Product Safety Directive includes quite a similar procedure to the safeguard clause known as the **rap**id **ex**change of information (RAPEX) system.

4.4 The Mutual Joint Visit Programme

4.4.1 Summary of all sectors [DGE01a]

This chapter is based on the *Final Remarks and Recommendations* –document made by the European Commission after the first Mutual Joint Visit Programme (MJVP) between national market surveillance authorities in 1999 and the presentations made by the Commission at different events and meetings. The NA Directives which were involved with the MJVP were: Toys (TD)[xxx], Personal Protective Equipment (PPED)[xxxi], Machinery (MD) and Electrical products (LVD and EMCD). The analysis of the five data sets for the above mentioned NA directives provides a wealth of information on the current situation and practices in market surveillance in the member states, including models of good practice, good case study material and innovative ideas.

The goal of the programme was a uniformly high level of enforcement of internal market legislation. The benefits of the MJVP were proactive solutions, personal links and the identification of strong and weak points. The main issues that were raised following visits and reports were

[xxx] Council Directive 88/378/EEC of 25 June 1987 on the approximation of the laws of the Member States concerning the safety of toys. Amendment 93/68/EEC.
[xxxi] Council Directive 89/686/EEC of 21 December 1989 on the approximation of the laws of the Member States relating to personal protective equipment. Amendments 93/68/EEC, 93/95/EEC and 96/58/EC.

resources, measuring effectiveness, common statistics, visibility and transparency, information exchange, confidentiality / access to data, safeguard clause procedure and cooperation with customs.

Very little statistical data was submitted by member states and in many cases it was submitted in very varied forms. This in itself is a reflection on current practice in market surveillance of the NA Directives. For example, a low number of prosecutions in Finland is seen as a positive result as the state has a policy of negotiated solutions with manufacturers. In another state, where market surveillance is in its infancy, the same low figure would be viewed negatively.

One of the key issues in moving member states forward from running reactive market surveillance strategies to taking more proactive approaches, is the strength of coordination between competent bodies and other associated organisations and the ease of the flow of information between them. Examples abound throughout the MJVP where coordinated strategy and good information flows lead to economies and efficiencies in market surveillance. Models of good practice could be identified and used to particular effect to assist new and accession seeking states in setting up market surveillance systems.

There is incontrovertible support across the member states surveyed for the notion that more, and more specific, cooperation at EEA level leads to benefits in terms of more efficient market surveillance. Evidence to support the notion can be seen from existing successful cooperation: [1)] Joint market surveillance projects, for example the personal protective equipment project in Nordic countries, [2)] models of good practice applied in every subject, [3)] cooperation with custom authorities, [4)] the use of closed access Intranet databases by authorised surveillance officials, [5)] shared research and innovation; for example, the Danish toy campaign directed towards assessing the link between the amount of toy testing and the number of unsafe toys uncovered. The results could provide useful information for other member states at a similar stage in their development of toy safety testing.

Support is strong for the idea of rapid information sharing across the EEA states. In the short space of time since the MJVP was submitted, a wealth of new technology has become available as a result of the boom in e-business. If IT-platforms now exist to support highly complex global internet distribution and supply chain systems for the retail industry, e-business must surely present new options which can be transferred to and adapted for market surveillance activity. For example, Norway mentions the new generation of barcodes being developed for retailers, which carry highly detailed information about the origin of the product. This technology might equally find a role in improving the traceability of products or in speeding up checks at borders. The advent of e-business has led to the creation of global standards in data protection and the introduction of digital

signatures and other security methods, which render possible concerns about member states sharing databases as being obsolete. Several member states have already created websites and on-line databases and the ease and speed with which information can be shared, together with the low costs involved, suggest that this is the way forward for planning campaigns. No member states have yet attempted to monitor products for sale via the Internet.

The MJVP reveals varied detail on the advantages and shortcomings of the safeguard clause procedure and could almost be said to present a work programme of improvements for the Commission. There was much support for the RAPEX procedure of communicating news of unsafe products, particularly toys, across the EEA countries. The wealth of detailed comment suggests several improvements could be made to the way cases are notified.

The MJVP was undertaken in 1999 and there were several references by member states to future plans which included reorganisation of market surveillance activities, such as: [1)] Planned reorganisations of market surveillance authorities (The Netherlands, Portugal, Greece); [2)] Changes in national legislation (Ireland, The Netherlands); [3)] Other planned improvements (better co-ordination between federal states in Germany). After the MJVP, the DG Enterprise has decided to put forward support for market surveillance activities such as directive-specific Administrative Cooperation Working Groups (ADCO), cross-sectored administrative cooperation and cross-border market surveillance projects.

4.4.2 Electrical products [DGE01b]

The MJVP revealed that LVD/EMC market surveillance among EEA countries is quite well-established when compared to other directives. The most complete statistical records were received for these directives. EMC market surveillance systems were somewhat less well established than LVD and some EEA countries have notable gaps in their provisions for EMC market surveillance. For example, at the time of the MJPV (1999): [1)] Italy and Greece had no notified bodies for EMC; [2)] in the Netherlands, electrical goods were not checked at Customs at all providing a gateway for the influx of potentially unsafe products into the rest of Europe; [3)] EMC surveillance was in its infancy in Portugal; and [4)] there was reportedly no real systematic checking of products under the EMCD in Italy.

While the issue of limited resources features in every country's explanations with regard to every directive, it is perhaps more of an issue due to the huge number of product types on the market which fall within the ambit of the directive. For example, in Finland, which has a relatively small population, there are still 50,000 different types of household or office product affected by EMC/LVD requirements plus another 10,000 products used in industry. The German market – with

80 million people - purchases 250 million appliances and components each year. Severe financial restrictions - such as Ireland's test budget of just £IR15.000 (1999) – mean that the effectiveness of market surveillance is negatively affected. Resources for training are a key issue in this specialist area. Fig 4.2 shows wide variations in the human resources available for LVD/EMC market surveillance in different EEA countries. Also, according to a newer study [RPA02], the level of public resources devoted to EMCD enforcement differs considerably between the EEA countries, with expenditure varying between less than 20,000 € per year to many millions of Euros per year. The majority of respondents in [RPA02] spend more than 100,000 € per year on enforcement of EMC regulations, most responding authorities (60 %) also employ staff specifically to deal with EMC issues.

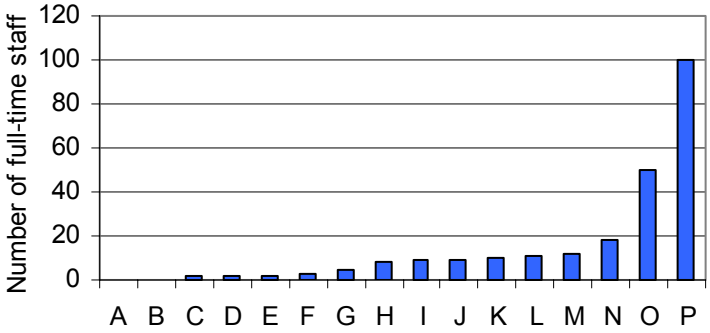

Fig. 4.2 An approximate graph of EEA countries' human resources dedicated to market surveillance in 1999; the letters A-P represent countries [DGE01b].

Fig. 4.3 a) shows how annual work plans and strategy to discover non-compliant products are done in the EEA; a 'reactive' annual plan and strategy covers activities such as response to complaints, Safeguard Clause notifications and basic Customs checks; a 'proactive' approach suggests targeted campaigns, use of risk assessment tools, special cooperation with other authorities, e.g. Customs, manufacturer's associations, consumer groups or media. Fig. 4.3 b) shows how member states take action before a product is placed on the market. Activities classified as reactive would be e.g. putting the onus on manufacturers to obtain guidance on the requirements of the directive or simply referring manufacturers to notified bodies for information. A proactive approach covers seminars and workshops on the directives directed towards manufacturers' associations; website information, targeting design groups, etc.

EMC testing can be expensive and requires specialist facilities managed by qualified experts. Some countries do not have these facilities, in some other countries authorities are seeking to cut the cost of testing by providing inspectors with portable EMC testing equipment or 'laboratories on wheels' which can perform on-site testing. The UK is seeking to work with manufacturers to create

competitively priced EMC screening facilities. Also, the need for more publicity for EMC market surveillance was a recurring theme. In several MSs, prohibitions on non-compliant products were not publicised. It is possible for a vendor to sell a non-compliant product to a customer with neither party knowing that the product is non-compliant. Market surveillance would benefit if consumers could be made more aware of the safety issues concerned and hence, became more active in reporting non-compliances.

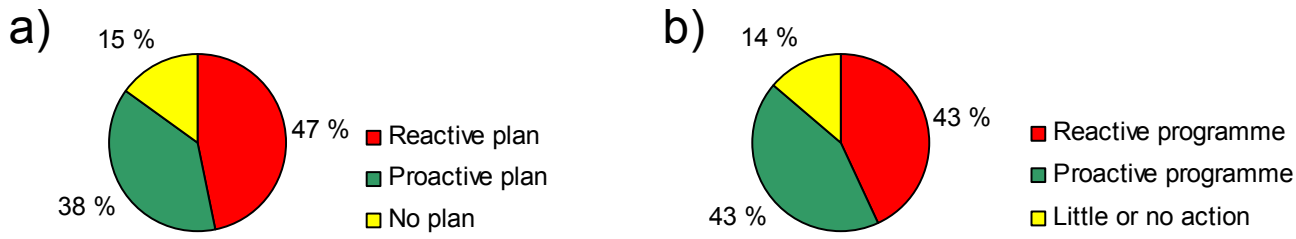

Fig. 4.3 EEA countries' monitoring strategies of products placed on the market; a) Annual work plans and strategy to discover non-compliant products; b) Activities before a product is placed on the market [DGE01b].

Fig. 4.4 shows the number of samples taken and the number of non-compliances found in different EEA country. The countries have been graded – from the least active in the field to the most active. For some of those rated with zero the answer was either missing or not relative. The relationship between the number of samples taken and the number of non-complying samples discovered is such that a greater degree of testing produces only a small number of non-compliances. The discernible direction here is unfortunately in the small number of EEA countries registering any activity at all in this field. Fig 4.5 shows the number of prosecutions, written warnings, recalls and suspensions made by EEA countries In Figures 4.2, 4.4 and 4.5, the same letter (A-P) do not automatically mean that it represents the same EEA country in each case.

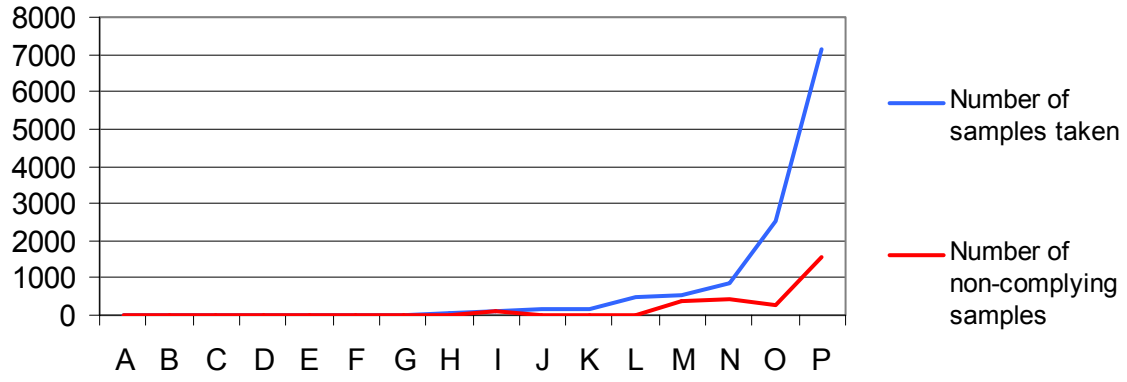

Fig 4.4 Numbers of samples taken / Number of non-compliances identified in 1999 [DGE01b].

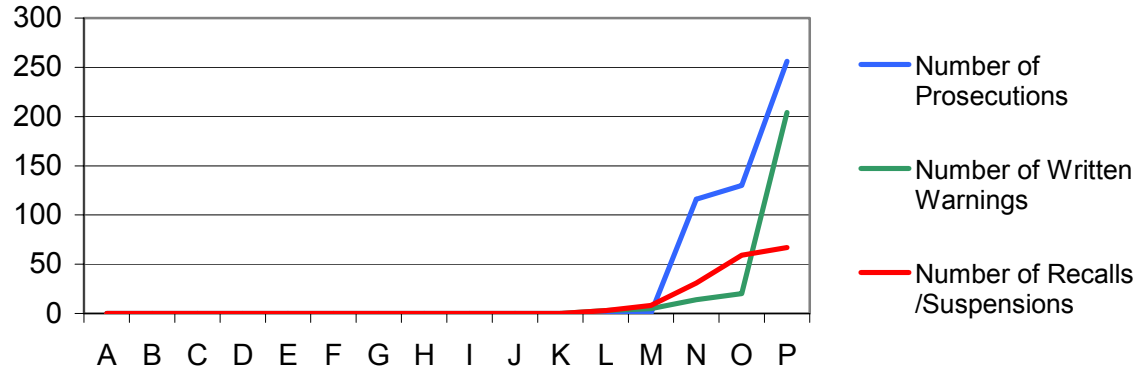

Fig. 4.5 The number of prosecutions, written warnings, recalls and suspensions made by the EEA countries in 1999 [DGE01b].

Those MSs with more proactive approaches to market surveillance tend to have wide-ranging cooperation between authorities within their own country and good flows of information. This is the case even when cooperation is on an informal or ad hoc basis. Regarding cooperation with authorities in other member states, the most frequently mentioned contact points were: LVD ADCO, EMC ADCO, LVD Working Party, EMC Working Party, Nordic cooperation and Baltic cooperation.

A case study worth mentioning is the UK's experience in working more closely with manufacturers. Trading Standards Officers from Cardiff County Council purchased four standard 486 computers from local manufacturers and tested them at a competent testing laboratory. All four failed to meet requirements in spite of the manufacturers having received information and guidance on the regulations. Even though two of the four companies were prosecuted and fined, inspectors offered to help them develop due diligence systems. Thanks to the proactive attitude of the Trading Standards Officers, all four companies have commendable records in compliance and a screening project has been established with an approved test house offering companies competitive priced screening for products falling under the EMC/LV Directive.

The possibility of making databases available to other member states receives some backing with reservations concerning data protection, the possible difficulties involved in supervision, etc. More support is therefore discernible for sharing information freely via the Internet. Sweden and Finland, for example, already produces lists of products, which have been withdrawn from the market, available via the Internet.

Of the 13 EEA countries responding to the question about what experience has been had with regard to safeguard clause procedures. Five countries had used the system**,** four had not and three expressed a preference to using it for serious cases only. The RAPEX system is used for products

relating to the LVD only. Policy on whether other member states should automatically be notified at the same time as the Commission was split, with four member states wishing to informing other member states directly and three opting not to inform others at all.

Respondents noted a wide range of concerns and areas for improvement, most of them falling under the following headings: [1)] *Human and Financial Resources*; specialist training for staff, on-site testing facilities, higher budgets for testing and help for member states with below-par systems of market surveillance in this field. [2)] *Cooperation with other member states;* information on products prohibited in other EEA countries, suggestions for using new generation of barcodes on EMC-related products in order to improve traceability. [3)] *Problems with member state's organisational set-ups;* better cooperation with Customs needed, better information flows needed – more use of internal databases. [4)] *Information flows*; more publicity on non-compliant products needed directed towards consumers. [5)] *Non-clarity of standards*.

4.4.3 Auditing of Finnish EMC/LVD market surveillance [DGE99]

This section shows a short review of a reported occasion when Finnish EMC/LVD market surveillance was seen to be in action. A visit to Finland was made in May 1999 by an auditing group which included two experts from both Austria and Italy.

In order to familiarise visitors with how the Finnish market surveillance system works in every-day operations, visits were organized to two retailers outside Helsinki. One of the three accompanying TUKES field inspectors demonstrated a typical method of TUKES's market surveillance field work by seeking electrical products on sale and checking them with the TUKES database lists of previously investigated products, paying specific attention to recorded non-compliant equipment. By this method the field inspector is very quickly able to establish, which products are completely new and what electrical equipment has come from companies (manufacturers or importers) from which, non-compliant products have been known to come. Normally, doubtful products are bought by the inspector for further investigation by accredited laboratories.

As a result of a Swedish notification under the LVD safeguard clauses procedure concerning a specific electronic timer, the field inspector purchased a sample of a similar product in order to check its compliance with the applicable safety requirements, and with a mind to further investigation. During the outing to retailers, the following instances of notable shortcomings were found on a luminary wall mounting on which the recorded wattage was indicated on a label fixed to the lamp holder. This marking was covered by opaque glass. As a result, recorded lamp wattage could not be visible during lamp replacement, putting the user at some risk. Further, there was a

steam cleaning device which bore a warning label in German only. In addition, the appliance carried a warning symbol, which was not explained in the user instructions. Without a safety warning in the language of the country or/and an explanation of the meaning of the warning symbol in the instructions, the safety objectives are not provided for. The visitors said that the presentation of Finnish market surveillance in practice had displayed the outstanding efforts taken by TUKES in the field of electrical safety.

The auditing group suggested for the following improvements to the Finnish system: [1)] increased collaboration with other national sectored authorities to encourage increased common activities and possibly, methods; [2)] use of risk analysis when determining the impact of the various market surveillance measures; and [3)] increased cooperation with other EEA market surveillance authorities in finding non-compliant products having similar technical constructions (faults) but differing type designations.

4.5 Research Related to Product Conformity Enforcement in Finland

In Finland, product enforcement is mainly carried out through market surveillance, because the free access of CE-marked products to the market must not be obstructed. In [VAA02] and [Mat00] the Finnish product surveillance system is extensively described. Scientific research related to product enforcement is slim. However, in Finland we are pioneers; proof can be found in such research as [Sim99]. Also studies [Raj00a] and [Pir01] deal with product conformity enforcement. Consumers' opinions and attitudes in relation to electrical safety and the ways of using electrical equipment have been gone into in [Saa01].

4.5.1 Functionality [Pir01]

In market surveillance, thousands of products and product groups are inspected yearly in Finland. Monitoring authorities discover a lot of faults in products. Other than technical faults, problems can be in their markings and in instructions etc., but problems have nearly always been resolved in discussions with the representatives of the importer or manufacturer who delivered the product onto the market. The manufacturer or its agent normally reacts positively with regard to authority instructions. It corrects faults so that the product fulfils the requirements of conformity or voluntarily withdraws the product from the market.

Very seldom are stronger methods required. The monitoring authority can impose a sales ban, an import ban or a marketing ban and possibly have the product withdrawn from the market. The annual occurrence of such cases varies; depending on the number of inspections which have been made. The majority of cases which lead to a sales ban concern electrical products as well as

teleterminal equipment. Another group which continuously receives bans is in the meat and processed meats sector. The grounds for bans in these groups are clear and, for this reason, the cases do not lead to further measures.

With regard to other food products and consumer products, banning decisions are taken only occasionally. Few cases have led to further measures, when the importer who brought the product onto the market, finds the grounds for the ban based on national legislation opposes community legislation. The EC Court of Justice's decisions might remove the national requirements for some product, or confirm the legality of an individual country's exceptional requirements.

The operation of market surveillance is easier, when the legislation concerning a product group is harmonised at community level. But even then, there might be problems since regulations can be interpreted in different ways and manufacturers think that it may lead to wrong decisions. Surveillance of non-harmonised product areas is more difficult, because national statutes can vary a lot among member states.

Finnish companies had hardly anything negative to say about Finnish product surveillance operations or methods. Authorities were considered to operate in a business-like-way and their flexibility was appreciated. The only criticism was that many Finnish Authorities and their personnel tended to be 'too exemplary' compared to some other member country officials who were undisguisedly favouring their own country's companies. This criticism is a paradox depending on the free movement of goods.

4.5.2 Electrical equipment [Sim99]

The study [Sim99] clarified the quality of the safety of the electrical products on the Finnish market before the period of the obligatory pre-approvals (1966-1976), during the period of the obligatory pre-approvals (1980-1993) and after the periods of the obligatory pre-approvals. According to statistics, the number of fatal electrical accidents decreased during the period of obligatory pre-approvals when compared to the period preceding the time of obligatory pre-approvals. Inference from this was that obligatory pre-approvals with market post-control are an effective way to secure the safety of electrical equipment and materials entering to the market.

Post-control does not fully prevent the entrance of dangerous electrical equipment onto the market because controls concern the products already on the market. In Finland as well as in Denmark, where they have the most experience of market surveillance, the situation seems to be established and no noticeable deterioration or improvement has taken place as far as electrical accidents are concerned. In both countries, the instructions and information to consumers has

increased following the obligatory pre-approval period and these measures have prevented accidents.

Although the system of obligatory pre-approvals has been withdrawn in Finland since it entered the EEA, the level of safety seems to have remained good. This is because of the quality control of production, market surveillance and improved information services. To guarantee the free market in the EEA, the CE marking has been introduced. It should show that the product bearing it fulfils safety requirements. In practice the CE mark has been even used on dangerous products. According to [Sim99], post-control of the use of the CE mark carried out by national authorities does not guarantee the safety level of electrical equipment and his opinion is that the use of the CE mark should be licensed and use should be controlled at the point of manufacture; e.g. the surveillance of the use of the marking at the manufacturer's factory should be carried out by national testing and certification bodies.

4.5.3 Consumers Have Healthy Attitudes towards Electrical Safety [Saa01]

TUKES and the National Consumer Research Centre have studied consumers' opinions and attitudes in relation to electrical safety and the ways in which electrical equipment can be used. The study was carried out by means of a representative random sampling mail questionnaire, responded to by a total of 1,149 persons. The study gives a very good picture of Finnish consumer safety attitudes and awareness and it also reveals differences between various population groups in the country. Male and young consumers, and people with higher education or higher incomes take the most risks with electrical equipment.

Most consumers are proactive in forestalling hazards by checking that the electrical appliances at home have been switched off when they leave, or by seeing that the TV set stand-by state is off at night and when there is nobody in the premises for some time. On the other hand, some people still take unnecessary risks by leaving a clothes washing machine on or a dishwashing machine running or even a kitchen stove or oven switched on when leaving home. In some cases electrical appliances are also used inappropriately, e.g. the stove surface is used as an auxiliary table and equipment intended for indoor use are taken outside.

Nearly every sixth consumer repairs electrical appliances themselves, usually, light fittings and hand-held tools. Many people take considerable risks to themselves and their families by repairing defective cables with adhesive or insulation tape. Every fifth respondent said it was worth repairing a defective electrical appliance themselves whenever possible, since it was more economical. However, most consumers clearly stated that they preferred using an electrical professional.

Every fourth consumer had experienced electric shocks, and about every sixth had experienced the threat of fire caused by electrical equipment. Half of those who answered the questions were worried about the safety of electrical equipment. Of domestic electrical equipment, TV sets were considered the most dangerous and kitchen stoves as the next dangerous group. Fire is the electrical risk that most people are afraid of. Almost every home has a fire alarm because they are compulsory. More than half of them have a first aid kit, every third, a portable fire extinguisher, and every fourth, a fire blanket. Most consumers use the equipment safely, but certain groups act more riskily than others.

Based on the results of the study [Saa01], safety might be a notable competitive edge for manufacturers and sellers. Since consumers are concerned about product safety, this feature should be strongly stressed in both product development and marketing efforts. On the other hand, safety is far from a visible factor at the actual moment of purchase, since only one out of ten respondents said safety was one of the major issues when making a purchase decision. Instructions for use were read carefully, and four out of five consumers always or often study them before starting to use a new unit.

5. Research Material and Used Methods

5.1 Analysis of the EMC and LV Directive Enforcement in Finland

The analysis of TUKES's market surveillance system for electrical equipment [P1] was a piece of comparative qualitative research in which the European Foundation for Quality Management (EFQM) criterions was used for evaluating the functionality of TUKES's market surveillance system. The research material was mainly secondary type and accumulated in part with TUKES's basic operations.

The EFQM is a practical tool for helping organisations by measuring where they stand on the route to excellence. It also helps them to understand what weaknesses exist and then stimulates solutions. The EFQM model contains nine 'boxes': five of which are 'enablers' and four are 'results'. At the heart of the model lies the logic known as *RADAR*, which consists of four elements: [1)] Results, [2)] Approach, [3)] Deployment and [4)] Assessment and Review. The EFQM provides two evaluation tools: [1)] the Pathfinder Card and [2)] the RADAR Scoring Matrix. The Pathfinder Card is a self-assessment tool for identifying opportunities for improvement. The purpose of Pathfinder is to assist in the identification of improvement opportunities and to help in the building of improvement plans. The Pathfinder reflects the RADAR logic. The EFQM model and how to use it for assessment and scoring, is described in detail in [EFQ99].

The EFQM 'boxes' applied in [P1] are criterions 5 and 9. Criterion 5 "processes" deals with how the organisation designs, manages and improves its processes. It contains five sub-criterions. Criterion 9 "key performance results" handles what the organisation has in reality achieved in relation to its planned performance. It contains two sub-criterions. The Pathfinder Card has been applied to each sub-criterion.

5.2 Interview Surveys

Two interview surveys were included in this thesis. The population of these studies was Finnish manufacturers and importers of electrical equipment whose product(s) had been subjected to TUKES's market surveillance testing. TUKES's market surveillance activities have been collected together in the TUVA database. It contains information about 3,700 manufacturers and 1,400 importers whose product(s) have been tested. A sampling research method was applied in both interview surveys. The research material of these surveys was primary and accumulated by the interviewing parties concerned.

Another study was a piece of comparative qualitative research, which compares how different importers procure and promote goods for the luminary market [P2]. Luminaries were especially selected because they had been one of the most problematic product categories. The selection of luminaries checked in this study included luminaries with mains transformers, lighting chains, roof lights and wall, standard, table, flood and hand lamps. Research material consists of semi-structured face-to-face interviews and TUKES's database for product enforcement. Interviewed importers were selected from the database so as to both represent companies [1] whose products had been problematic and [2] those whose products had had only a few minor safety problems. A total of ten Finnish luminary importers were interviewed so as to establish their methods of operation. The cases of these ten importers encompassed 35 % of all cases within studied luminary categories. With regard to sales bans, 38 % of all those issued could be found amongst the importers interviewed. Interviews were built around 30 questions.

The opinions of Finnish manufacturers and importers of electrical equipment concerning safety and the EMC market surveillance mechanism operating today, as well as TUKES's methods, were clarified through a telephonic survey [P3]. A total of 51 persons were interviewed, with a control group of 50 persons, representing companies who had at sometime had their operations commented on by TUKES. The telephone interviews were carried out by Taloustutkimus Ltd. for TUKES, in September 2001. The purpose of the study was to make clear the opinions which manufactures and importers of electrical equipment had concerning market surveillance, since, in fact, their products had at sometime or other been the subject for measures and decisions by the market surveillance Authority. This study wanted to examine the feelings of the subject group with regard to the surveillance process and TUKES's measures. The under-riding purpose of this study was to support the development of TUKES's operations and client services. The study was realized by way of a quantitative telephonic interview. The sampling was made up from the market surveillance database of TUKES. Besides the contact information for the sampling, it contained information concerning the product group (electrical safety/EMC) and the measure, which had been applied. TUKES provided Taloustutkimus Ltd. with 238 pieces of contact information concerning electrical equipment cases from the target group and 155 pieces from the control group. The interviews were made by three professional interviewers from Taloustutkimus Ltd. using a computer-aided CATI-system. The interview work took place in a telephone interview studio. The information was collected between 17-26.9.2001. An average duration for a single interview was about 12 minutes. The results were shown by average values and percentual distribution, and they were cross tabulated according to background variables. The statistical significances of results were tested with

t-test using a 95 % confidence range. The free-formed spontaneous answers were collected and evaluated using qualitative methods.

5.3 Analysis of EMC Market Surveillance Projects

The population of products tested in EMC market surveillance projects covered all electrical products on the Finnish market which belong to the TUKES's enforcement realm. The first sampling was made when the product group was selected to be the subject for a project. Information used when selecting the subject has been: [1)] product and interference complaints, [2)] TUKES's own earlier market surveillance test results, [3)] other member states' market surveillance results and [4)] TUKES's own discretion when following field observation. To date TUKES has had four EMC market surveillance projects: [1)] uninterruptible power systems (UPS) [P4], [2)] personal computers (PC) [P5], [3)] frequency converters [P6], and [4)] energy saving lamps [P7]. All these projects required that the Finnish market for the product group in question was monitored and manufacturers and importers identified. A significant amount of documentation was requested and thoroughly checked for every project.

The sampling of products to be tested inside the product group was carried out totally impartially and extensively. Every attempt was made to assure that the sample pieces from every manufacturer and importer selected were of quite similar types, but at the same time they represented typical products of the enterprise in question. The third sampling was made when the EMC tests, which were carried out on the product group in question, were selected.

The main focus of these projects was a market surveillance operation, but the material accumulated was also studied for R&D purposes. The studies concerning TUKES's market surveillance projects were mostly pieces of qualitative research and qualitative methods were applied, although they were supplemented by quantitative methods, when possible. All four studies included [1)] a descriptive part in which the market surveillance tests and their results were shown; [2)] a causal part which explained the observations made; and [3)] an evaluation part which analysed the requirements for the product group in question. The reasonableness of requirements was checked so that it could be seen how [3a)] technically they worked and how they worked [3b)] administratively.

5.4 Statistical analysis of the TUVA database

The research material for statistical analysis of the TUVA database [P8] consists of active market surveillance cases, which were assembled into the TUVA database between 1994 and 2000. In this study, *an active market surveillance case* means that, according to the TUVA 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 TUVA 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 [P8] consists of 9007 cases. It should be noted that all cases do not include the necessary information for all special pieces of study, or possibly a case in question does not have the characteristics needed for special examination. For this reason, not all examinations cover all 9007 cases. The number of valid cases in the study in question is noted in the section for a specific examination. In [P8], the TUVA database is statistically analysed by using the SPSS programme [SPS99]. The research methods applied are: observational matrix, frequency analysis, correlation analysis and chi-square tests.

In another statistical study [P9], two sets of interference statistics have been compared against those of the EMC market surveillance statistics made by TUKES. The main focus has been on electrical equipment. The aim of the study is to find out whether there is a potential use and usefulness for the applying of interference statistics when evaluating the effectiveness of EMC market surveillance, and also when in allocating EMC market surveillance financial and personnel resources. Also, the costs of EMC market surveillance have been compared against the costs of interference problem resolving. Comparisons between different distributions have been made by using the chi-square test for equality of distributions [SPS99], [Hei99]. After the chi-square value has been calculated, the level of significance associated with the chi-square test has been looked up in a specific table[xxxii].

[xxxii] http://fonsg3.let.uva.nl/Service/Statistics/ChiSquare_distribution.htm

6. Summary of Publications

6.1 Analysis of the EMC and LV Directive Enforcement in Finland

6.1.1 Publication [P1]

The Safety Technology Authority of Finland (TUKES) is a governmental agency. It is responsible for providing enforcement, development and safety communication services in its fields of operation. TUKES operates throughout Finland and its activities are based on its authority as laid down by law. TUKES was established in 1995 as a result of European integration and the reorganization of public administration. TUKES's scope of activity covers plant and installations surveillance, product safety enforcement, research and development as well as support services. Altogether, about 115 persons are employed by TUKES.

TUKES has three roles to fulfil: [1)] enforcement, [2)] communication services and [3)] research and development. In addition to surveillance, communications are required to advise entrepreneurs and consumers about product requirements and how products should be correctly used. Research & development ensures that approaches in use are effective and up-to-date.

Product safety enforcement seeks to ensure that products are designed, constructed and used according to the purposes for which they were intended. Products subject to surveillance include electrical products, legal metrology, articles of precious metals, pressure equipment, aerosols, gas appliances, chemical tanks, explosives, the packaging and containers used in the carriage of dangerous goods, rescue service equipment and construction products. The features subject to surveillance are safety, EMC, reliability and energy efficiency. The aim is to ensure product safety, reliability and adequate environmental compatibility. There are two different systems applied in product safety enforcement. Most products are those referred to in the NA directives, while others are subject to national requirements. As far as products referred to in the directive are concerned, TUKES is responsible for ensuring that the manufacturer has carried out the internal controls of production. In harmonised sectors, this is done through market surveillance. Quite a similar system is used in non-harmonised areas, too.

As a rule, market surveillance is carried out actively but in the case of some products, reactive control is sufficient. Market surveillance approaches include field supervision, documentation supervision and specific surveillance projects (see Fig. 6.1). If required, field supervision can involve sampling. Samples are tested and results assessed. Reaction decisions are taken based on these assessments. With regard to products not referred to in directives, TUKES applies market

surveillance approaches to products already on the market, and assessment requirements that apply to products prior to market launch. For example, in the case of pyrotechnics, TUKES's approval is required before a product can enter the market. In the case of articles of precious metals, the sponsor's maker stamp must be approved before they can be sold.

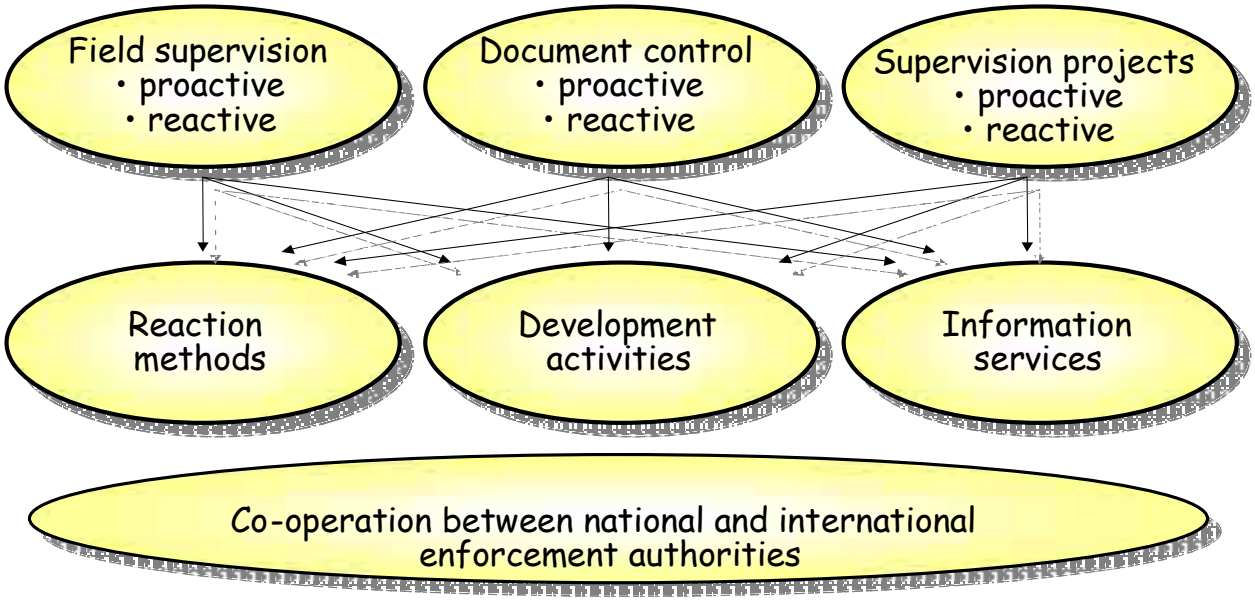

Fig. 6.1 The enforcement methods for the NA directives as applied by TUKES [Nur99].

Electrical equipment and appliances intended for public use have previously been subjected to obligatory pre-approvals. This was changed at the beginning of 1994 when Finland became a member of the EEA and therefore implemented the LVD and EMCD. Under the old system, general safety and EMC regulations were issued by the Ministry of Trade and Industry (KTM) and product oriented regulations, by the enforcement authority. At that time, standards were in practice mandatory. Regulating, testing, approval and market control were carried out by the same body. Adaptation to EU legislation meant that the conformity assessment system had to be changed. This was done through a new act called The Electrical Safety Act. According to this act KTM lays down the general safety and EMC regulations which have been derived from the appropriate directives. Standards are voluntary and a new Authority, TUKES, was given the responsibility for the market surveillance aspect. Testing, certification and inspection are carried out by independent and governmentally authorized bodies working on a commercial basis.

TUKES supervises the electrical safety and EMC of electrical appliances and accessories sold in Finland. Focus has been on safety enforcement but EMC enforcement, too, has been regularly carried out. TUKES inspectors visit electrical appliance manufacturers, importers and vendors. For testing and inspection purposes, inspectors purchase those appliances they wish to ensure the compliance of. Types of an appliance which are considered to constitute a risk are withdrawn from

the market or even, more drastically, the hands of the consumer. Testing is performed in independent competent testing laboratories. The required course of action is taken at any given time with respect to any safety shortcomings discovered through testing. Table 6.1 shows the measures which TUKES applies depending on seriousness of defect.

Table 6.1 TUKES's market surveillance measures

Measure	Description
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.
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.
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.
Caution	A product has a slight safety or EMC fault, which should be corrected by the time the next product series come onto the market.

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 retailer prices. Since the latter part of 1996, in cases in which products have proven to fail to conform to regulations, TUKES has demanded repayment for the costs of purchases, as well as testing. This applies in recall, sales ban or delivery ban cases. Field inspectors from the Finnish Authority have from the commencement of the market surveillance system until the end of 2001, carried out about 21,000 surveillance visits to outlets, importers and manufacturers and in doing so, have purchased about 7,300 products from outlets which have then been tested. (See Fig. 6.2.)

TUKES's communications are based on amendments to legislation, the safe and interference free use of products and dangerous or high disturbance products that have come to its attention; information regarding the most dangerous products is made public via the Internet.

Most of the safety tests are carried out by SGS Fimko in Finland. TUKES takes advantage of further testing services by concluding annual contracts with SEMKO, the organization providing testing services in Sweden, and also with NEMKO, the organization providing testing services in Norway and Finland. To save costs, TUKES has refined testing methods together with the testing

bodies. This is an extension of what TUKES calls, 7-hour testing. At least two different competent EMC testing laboratories have been available in Finland during the whole of TUKES's operational time and TUKES has used the existing competitive situation to refine the development of the EMC services TUKES requires, taking into account competitive pricing as well.

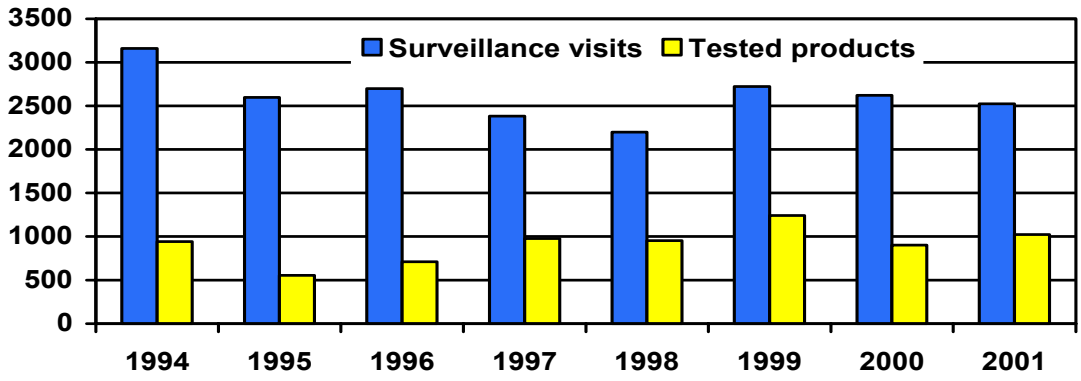

Fig. 6.2 TUKES's market surveillance visits and tested product volumes.

[1] Accident statistics, [2] observations made during inspection visits and [3] findings from market surveillance tests are the key features when monitoring the level of safety. Fig. 6.3 shows the total number of electrical incidents which TUKES has been notified about over the past six years. The number of fatalities arising from electrical incidents over the past ten years has averaged about three per year. Serious accidents involving elevators are rare, although they have shown a slight increase in recent years. Whilst no exact statistical data has been collected about the number of fires caused by electricity, the high number of them has led to TUKES undertaking research into electrical fires and concentrating communications on the prevention of them. According to [Nur01], electricity appears to be the cause of approximately 2,000 fires per year in Finland.

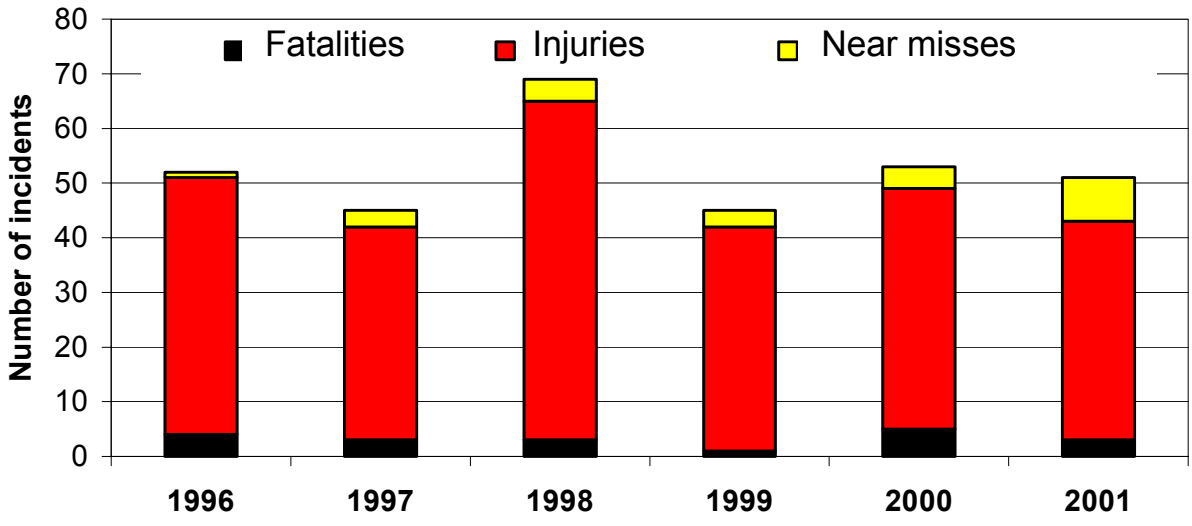

Fig. 6.3 Electricity incidents involving humans (those of which TUKES has been made aware of).

TUKES does not create statistics concerning EMI cases. The Finnish Communications Regulatory Authority (FICORA) identifies and clarifies the radio interference cases which have been reported to it. The number of interference cases would appear to be stable and stand at a little more than 300 cases per year. The proportion of cases in which electrical equipment is the source of EMI seems to be at a slight increase and it is now about 20 % of all interference cases.

In 2001, field inspectors from TUKES carried out over 2,300 surveillance visits to outlets and 190 visits to Finnish importers and manufacturers (see Fig. 6.2). Over 1,000 suspect electrical products were purchased for further detailed inspection and testing. About two thirds of tested products fulfilled the tests perfectly or had only minor shortcomings (see Fig. 6.4). Typical products with insufficient safety features were e.g. extension cords, chargers, luminaries and adaptors. Fig. 6.5 shows that the number of products tested in 2001 was over 10 % more than that of the previous year. However, the number of sales and delivery bans remained at the same level: delivery bans 71, sales bans 107 and recalls 23.

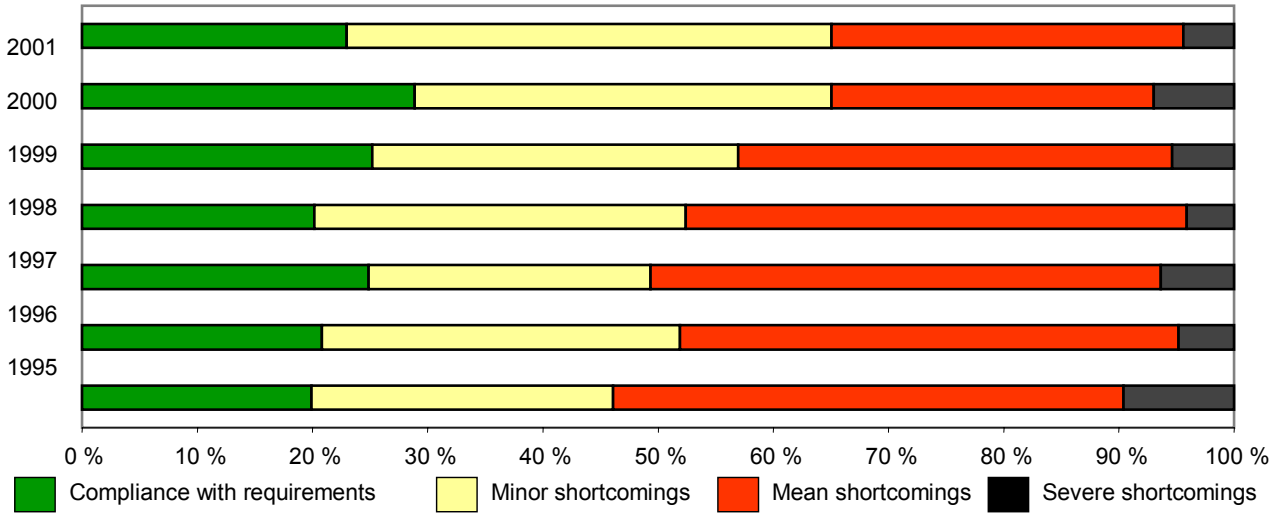

Fig. 6.4 The trend in the compliance of electrical products; TUKES's enforcement of electrical products, results of safety tests 1995-2001.

A positive trend could also be seen in EMC enforcement. In 2001, about 100 products were EMC tested, and in fewer than 20 cases notable shortcomings were found. As Fig. 6.6 shows, the number of tested products in 2001 was about 50 % greater than in 2000, but sales bans did not increase. The EMC features of household and AV equipment have improved, whereas EMC problems were found to be especially notable in PCs and energy-saving lamps.

TUKES finance allowed for in the State Budget has been adequate. The amount required during the formation stage was estimated at 10.4-10.6 M€. Operations failed to commence within the schedule and estimated scope envisaged at the planning stage. TUKES's human resources costs by area of responsibility have been divided so that enforcement is responsible for about 50 %, R&D

35 % and information services about 15 %. TUKES's operations address the prevention of accidents and products that fail to comply with the regulations. As far as use of resources is concerned, this means the role of R&D and safety communications will grow in the long-term, as will the resources used on them (added need). [Tuo01].

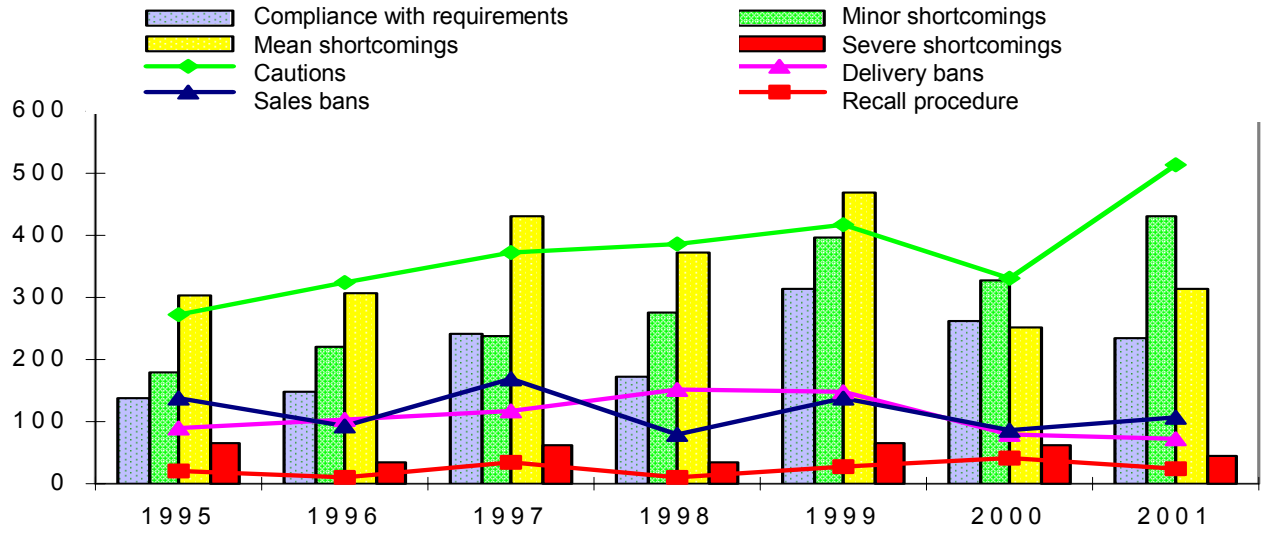

Fig. 6.5. TUKES's market surveillance findings and measures for electrical products over a six-year period. The bars show the annual numbers of findings from product tests, divided into four groups depending on the level of seriousness. The lines show the annual number of measures taken by TUKES on the basis of product test findings.

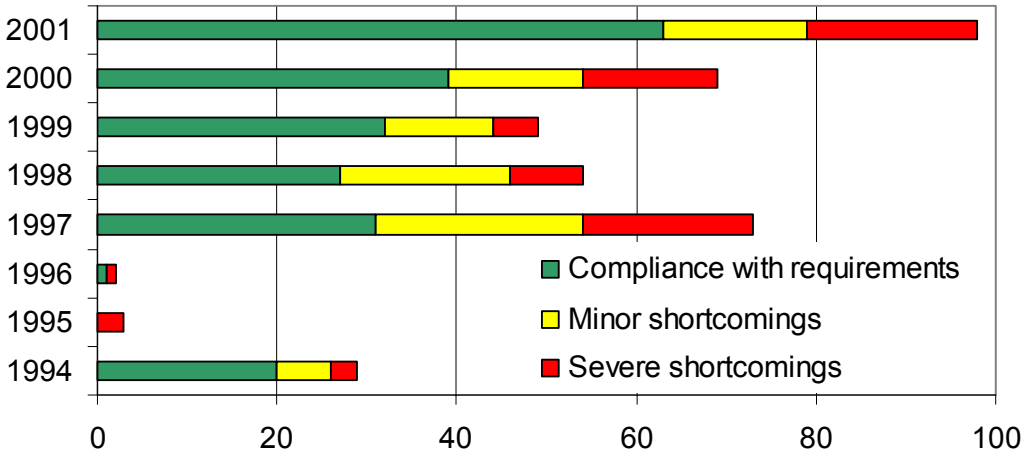

Fig. 6.6 TUKES's EMC market surveillance tests and findings.

6.2 Interview surveys

6.2.1 Publication [P2]

This publication examines the marketing channels importers of electrical consumer products use, when they procure new products from the Far East for their import ranges and how importers

market their products in Finland. The study set out to determine if there were any identifiable common factors in operations, which might make it possible for dangerous products to enter the market. The aim of [P2] was to establish if there were any prospects for developing new pre-retail stage market surveillance methods.

The structure of how trade is carried out and the channels for the marketing of new products are described in [P2]. Of further interest were the factors, which had influenced their decisions when selecting new products for their product ranges. We sought to establish how importers reacted to new products and to new manufacturers, and also, to find out how important continuity of business relations was to them. Attention was also given to the problems arising when importing electrical consumer products; also the factors importers considered as being big risk elements. Also important was establishing how marketing channels were created and the way they were used in the domestic market. Further, we sought to find out what criterion importers used when considering both the wholesale and retail sides of their business and also what responsibilities they, as importers, felt they had.

Decisive factors for the safety and conformity of a product are with the internal controls made by the manufacturer and in the carefulness and good sense of responsibility of the importer. An experienced and responsible importer can especially have a big influence on the quality of products imported from the Far East. The high number of manufacturers in the Far East leads to competition between factories. There is a ready buyer's market and factories are prepared to do nearly anything in order to keep their clients satisfied. It was apparent that the importer himself could mar the quality of his selected products through pushing for a too keen price for himself. It is clear, not all importers learn to respect or understand the emotive feelings behind Chinese business culture: it does not permit them to be negative or say no, and so they say 'no' by lowering component quality.

Based on notifications made by EEA countries, only about half of the non-conforming products in 2001 were manufactured in the Far East. But this is not necessarily the whole picture; many European companies have begun to subcontract out the manufacturing of their products, partly or fully to Far Eastern manufacturers. Also, many importers have begun to import products to Europe under their own trademark. In these cases, the home country of the owner of the trademark is considered to be the country of origin [EC99], and the person/company who originally manufactured the product is considered a subcontractor.

Due to long-standing business relationships, the quality of production in the Far East is improving the whole time. But the situation concerning those manufacturers, who have no long-standing business relationships, is not the same.

Many interviews brought out a common complaint from among importers; market surveillance was much too tight in Finland and Sweden. They thought that products, which get sales bans in Finland were allowed to be sold elsewhere in Europe without any problem. The number of LVD safeguard clause notifications made in 1999 tends to support this opinion; 62 percent of all notifications (173 notifications) originated from Finland or Sweden. But the situation has changed. In 2000 there were 332 notifications of which 44 % were from Finland or Sweden. In 2001, a total of 408 notifications were issued, and now 'only' 25 % originated from Finland or Sweden. The market surveillance of electrical products would seem to be getting better in Europe, little by little. Nevertheless, it would seem from statistics that the market surveillance systems of some member countries do not operate at all.

The lack of confidence in certification marks makes the operations of importers difficult. According to many interviews, especially the TÜV-certificate carries very little trustworthiness. The statistics for 1999-2001 show that 25 % of notifications were directed towards products having certification mark(s). Of all the notifications having the mark, 69 % had the GS-mark and 50 % had the TÜV-mark. In 2001, only 4 % of notifications were directed towards products having certification mark(s). So, the confidence in certification marks would seem to be increasing.

Importers find the biggest risks are in the continuing quality of production. Problems of quality are caused, because the on-going quality of products from production lines varies considerably. A second problem factor is that manufacturers exchange and change components without informing the importer. Sometimes the reason for this unexpected component change can be that the importer has trimmed the price down too much!

More information for and better orientation of retail and wholesale buyers would be worth investing in. The buyers in question purchase very extensive ranges of different kinds of products. So their knowledge of products in some product groups and also especially with regard to technical details of individual products, can understandingly be limited. By telling the basic facts about the requirements for electrical products and what the mostly apparent safety defects in each product group are, buyers would be helped towards making correct selections with regard to safety.

Some importers have agreements with factories in the Far East which require that the delivered product must be as agreed on and fulfil all requirements. If products are not as agreed or there are some safety defects, then the manufacturer must pay the costs, which are passed on to the Finnish importer. Also the importer should in all cases be able to return products, which do not meet conformity. The existence of this kind of practice should be made known to all European importers. This is one of the most important factors with which the quality of products can be improved. In

the long run, the application of this kind of practice will be a good thing for all parties (the manufacturer, importer, wholesaler, retailer, consumer and authorities).

The issuing and monitoring of certification marks should be made more effective. Also manufacturers should have greater responsibility for continuous production, which means that they do not only carefully manufacture the product to be tested so as to get certification, but also have to maintain the same high quality for the product throughout its production lifetime.

6.2.2 Publication [P3]

Finnish manufacturers and importers of electrical equipment appraised the existing market surveillance mechanism and TUKES's methods in a situation in which the sale of a product was restricted or a caution had been given because of non-compliance with requirements (EMC) or safety faults. Moreover, the necessity of market surveillance and matters linked to TUKES's information function were clarified.

The methods and procedure routines of TUKES in contact situations, prior to decision making, were found to be quite well conducted. According to respondents, the way in which contact was made and questions asked was relevant. The subjects had received enough background information and, also, enough time to respond to the questions put forward by TUKES. Also the proceedings concerning decisions and surveillance after contact were found to be extremely well managed: comprehensible instructions and information on how to make appeals, time frameworks and the clarity of requirements were very highly appreciated. With matters concerning test reports, respondents were comparatively satisfied, but with the conclusions drawn from them and with the stipulations included with decisions, a third was dissatisfied.

TUKES's routines in caution cases were also found to be satisfactorily managed. The test report was considered to be quite clear and factually constructive. On the other hand, one fourth saw that the caution was not quite or not at all justified.

The interviewees agreed in general that purchase and test costs incurred in market surveillance situations should be charged to manufactures or importers of products which do not comply with relevant requirements (41 % of respondents). 33 % of respondents felt that the state should cover all the costs of market surveillance. And only one tenth supported the idea of a surveillance payment fee that should be levied on every manufacturer or importer in the business.

In problem situations, the help which respondents got from TUKES was considered to be very good. The most critical feedback seemed to be that information was difficult to locate, because the entrepreneurs did not know where to get specific information if it did not come to them automatically. The most preferable ways to get information from TUKES about products which did

not comply with relevant requirements, were by way of Internet, e-mail, phone, TUKES's www-pages, brochures and by letter.

Further information about the technical requirements of equipment was much sought[xxxiii]. Also, further information was wanted about dangerous products and where specific requirements could be found. Information about the market surveillance operation principals in Finland and the EU interested only a few interviewees.

As for issues regarding the surveillance event and TUKES's decision-making, more attention should be paid to the clarity of test reports and whether it would be possible to improve them. Also the clarity of the requirements set in the caution should be improved. The conclusions TUKES draws regarding the dangerous nature/interference of products were criticised. It is difficult to improve customer satisfaction on these issues, since the view TUKES has of its activities differs very much from that of clients. It is, therefore, worthwhile considering whether TUKES can influence matters with its activities, or should the existence of dissatisfied customers be considered acceptable to a certain degree. In relation to the appropriateness of a caution, the same question as in the decision making regarding the dangerous nature/interference of a product and in the appropriateness of laid down requirements offset against the danger/possible interference caused by the device, come into the question: Should the existence of dissatisfied customers be accepted or can TUKES influence satisfaction through its own activities?

Most respondents considered that market surveillance in general was necessary and the necessity for TUKES's market surveillance was considered to be very real. One tenth of the interviewed considered it to be unnecessary and the reasons are covered in the freely answered questions response. Those in this 10 % thought that since the EU already supervises markets, Finnish market surveillance was a pointless overlap.

6.3 Analysis of EMC market surveillance projects

From 1997, almost half of the products for which TUKES has prescribed EMC market surveillance tests, has belonged to some market surveillance project. The main reasons for using the project method in EMC market surveillance are: 1) It is known that some products cause more EMC problems than others, and through application of a project, resources can be better allocated to those problem points. 2) Project results are normally easy to publish and so market surveillance gets more visibility and a higher profile. Both of these planks assist EMC market surveillance because when

[xxxiii] Conformity assessment bodies can provide this information but they demand payment for it.

the subject of surveillance realises that (s)he is under scrutiny, (s)he maintains his/her own initial control responsibilities more attentively.

6.3.1 Publication [P4]

In the Uninterruptible Power Supply (UPS) project, both emission and immunity tests were carried out for 14 UPS units. One apparatus was chosen from every Finnish UPS manufacturer and importer. Most of the units had a power rating of about 1.5 kVA, but not every manufacturer or importer had apparatus of this rating. The tests were carried out by two Finnish competent testing laboratories between May 1997 and January 1998.

The immunity requirements of UPS systems appear to be lenient and only one of the tested UPS units had some problems with one immunity test. No unit totally failed immunity tests.

Radiated interference field strength seemed to be the most critical measurement for emission tests. Large UPS systems with greater load currents had considerable difficulty fulfilling the absolute limits of EN 50091-2[xxxiv]. The number of UPSs that did not fulfil the EMC protection requirements was a surprising; 65%! The values for radiated interference limits for Class B (domestic) are 30 dBμV/m within the frequency range of 30-230 MHz and 37 dBμV/m within the frequency range of 230-1000 MHz when test distance of 10 m is used. The radiated interference limits for Class A (heavy industry) are 10 dB higher. If a unit did not fulfil the requirements of Class A, TUKES issued a sales ban on it. If a UPS failed Class B but fulfilled Class A requirements - and the users' manual did not list it as a Class A UPS - TUKES required a correction of markings. In such cases, TUKES also recommended that the EMC features of UPS should be improved to meet Class B requirements because many office premises are located in domestic dwelling structures.

According to EN 50091-2, emission tests shall be carried out with the UPS in the following conditions: rated input voltage, normal and stored energy mode, and a linear load that results in the highest interference level. The standard does not mention the battery load. It is important to note, however, that the loading measurement greatly affects UPS emissions. In the case of mains powering (the normal energy mode), the greatest interference takes place when the UPS is carrying its maximum load, the mains failure has just ended, and the battery requires its maximum recharging current. The tests performed in this project support this theory.

Seven of the tested UPS units were manufactured in the EU, and seven units were imported from non-EU countries. Only four units fulfilled requirements completely; two of these were from

[xxxiv] EN 50091-2:1995 + corrigendum Jan. 1998 "Uninterruptible power systems (UPS) – Part 2: EMC requirements".

the EU. Of the four units that emitted at least 15 dB above permitted levels, two were from the EU and two from non-EU countries.

A reason for the high volume of failures in the radiated emission tests might be attributed to the use of alternative test sites in original compliance tests. The standard testing distance is 10 m, whereas the minimum alternative test site mentioned in EN 50091-2 is a three metre distance. It is obvious that in small absorber-lined chambers or in open area test sites with high ambient noise levels, it is necessary to have the option of reducing the test distance from 10 to 3 m. A problem arises, however, in the use of extrapolation factors for radiated emission test data measured in distances shorter than 10 m. EN 50091-2 itself contains no mention of extrapolation factors, and, for example, EN 55011[xxxv] and EN 55022 [xxxvi] specify different extrapolation factors (0 dB/decade in EN 55011; 20 dB/decade in EN 55022). Both of these values can be easily faulted by theoretical examination or testing. In frequencies below 300 MHz, in which UPS systems normally produce the most interference, a 20-dB/decade correction, shows the biggest deviations. One noncompliant UPS system in the market surveillance project originally passed at a three metre test site with 20 dB/decade correction, and a declaration of conformity was written according to these tests.

From a market supervisor's point of view, alternative test sites are confusing. An accurate extrapolation factor valid for any kind of product is impossible to determine. The aim of EMC regulations is to maintain a tolerable electromagnetic environment, not to provide accurate measuring results. Market surveillance is necessary in order to maintain acceptable electromagnetic environments. Users of alternative test sites should know that the results from an absolutely standardized test site can and probably will be different. It is important to remember that a failure in a standardized market surveillance test could result in a sales ban of the product.

This market surveillance project's most useful information was gained from the discussions with manufacturers and test engineers. The most common reason for failures in EMC market surveillance tests is that often the products currently being manufactured are not the products for which compliance with standards had been measured [Raj00b]. Sometimes improvements have been made. Components may have been changed because of easier physical installation, better availability of alternative components, or a lower cost. Wiring is sometimes rerouted, or connector types are changed. In many cases, such design and manufacturing improvements do not equate to improved EMC. In addition, because EMC tests are time consuming and expensive, manufacturers

[xxxv] EN 55011:1998 (CISPR 11:1997) "Industrial, scientific and medical (ISM) radio-frequency equipment – Radio disturbance characteristics – Limits and methods of measurement".
[xxxvi] EN 55022:1998 (CISPR 22:1997) "Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement".

are not eager to retest products that have previously met EMC requirements, even for products whose manufacturing processes have changed. An accepted test report or certificate is worthless if the product has been modified since its original testing. Such products are considered incorrectly CE marked and on the market illegally.

6.3.2 Publication [P5]

In the personal computer (PC) project, 24 different manufacturer's product(s) were EMC tested. The test was performed according to EN 55022 by using an accredited test method, but only radiated emissions were tested for.

The observation of the project was that most of the PCs on the market did not fulfil the EMC requirements for radiated EMI. Only two PCs fulfilled norms the first time. Three PCs could be readjusted with small corrections. In seven cases excesses were so high that sales bans had to be issued. The sales ban decision was affected by the extent of excess radiation, its amount, and the wave-length the system was using when the disturbances became apparent.

The technology of PCs is burgeoning and the life time of a new manufacturing series is only a few months. A whole set of EMC tests for every new PC system is time consuming and expensive. For this reason the computer industry has understood the EMCD to mean that in assembling only CE marked plug-in cards, power supplies and other components, the whole system meets the essential protection requirements of the EMCD. In the directive there is no mention of this matter. The former guidelines of the EMCD said that the presumption CE+CE=CE could be applied but the guidelines on the application of the EMCD from 1997 abolished this procedure at the product level such as in the inside of the central unit of a computer.

Many PC integrators rely on their component suppliers to provide the necessary expertise and documentation to show compliance with the EMCD. This in itself causes problems, as there is as yet no consistent approach to using component data to demonstrate compliance on a completed PC. According to the measurements of this study, a PC which consists of CE marked components and equipment, can radiate excessive interference. The results indicated that the emission magnitude of most of the PC systems studied exceeded set limits. So, the results indicated that the equation CE+CE=CE does not hold true and as such the results support the interpretation of the present EMCD guidelines.

Many companies whose business it is to assemble clone micros are still under the false illusion that their products comply with all the demands of the EU when all the components used are marked with the CE mark. This is just not the case. The CE mark itself is not enough to make the component compatible with the demands of technical requirements. Putting the mark itself on a

component does not make it acceptable. The manufacturer who purchases components from external sources has a responsibility to check their quality and demand complete documentation relating to the components he uses. Even if the CE mark is correctly placed on components, it does not guarantee that a central unit assembled from such components automatically fulfils all requirements. A PC assemble company is also a manufacturer who has full responsibility for the quality of his products and for seeing that all the requirements demanded by the EMCD have been observed.

According to tests carried out in this project, the bus speed of the motherboard is a more significant cause of EMI than the clock speed of the processor. Radio interference should always be tested for whenever parts of casing, power supply or motherboard combinations are changed. Simple processor changing does not automatically demand new testing unless the motherboard has been altered in some way. The new resonances of busses and processor should, however, in these cases be carefully monitored. Other components used in assembling a PC should always be covered by the component manufacturer's test documentation which should contain information concerning tests made under authentic conditions, and what, in fact, the actual conditions were.

The following procedure for PC assemblers is suggested in [P5]: First, a risk analysis is needed for all the product families which are intended to be produced. All EMC critical components should be listed in the risk analysis, showing levels of EMI and degrees of immunity. The results of the tests of all the EMC critical components plus other relative documentation should be collected together. In those cases where the EMC critical component information is incomplete the component should be replaced by another which has fully acceptable information. The fulfilment of immunity requirements can be realized by way of the module principle (CE+CE=CE). This assumes that all components carry sufficient documentation on immunity properties and that assembly of components is in full compliance with the component manufacturer's instructions. If the power supply manufacturer has provided all the proper documentation concerning tests of low frequency disturbances, harmonics and flicker, this should be sufficient and no tests for the total computer need to be run. Following this, it is then possible to build up the most EMC critical combination thanks to the very detailed risk analysis information. The conducted and radiated RF disturbances for that combination should then be tested. If findings are found to remain below standard criteria, all other combinations as well can be CE marked and the SDoC can be issued. These proposed steps are only the minimum requirements which should be undertaken and are in no way a guarantee that all assembled equipment follows standard regulations. The manufacturer, in the final analysis, is always fully responsible for his product and the components therein.

According to the EMC guidelines only the ‘worst case’ need be shown to be compliant and the other variants of that apparatus can be included in it in EMC terms. Because almost every PC configuration is unique and PC integrators have little technical knowledge of the EMC characteristics of the components that they use to construct their product, it is difficult to define ‘worst case’. PC builders do not have the necessary equipment or knowledge to carry out EMC testing themselves and the costs of testing individual assemblies would be excessive.

6.3.3 Publication [P6]

In the third EMC market surveillance project, the tests for frequency converters were performed in accordance with EN 55011 or EN 55022. We used the same standard according to which the SDoC was asserted. In these standards the equipment is classified under two categories: *Class A* and *Class B*. *Class B* equipment is suitable for use in all establishments whereas *Class A* equipment is suitable for use in all establishments other than domestic ones.

In the project, only emissions were tested. We did not consider expensive immunity tests to be necessary since the requirements for immunity are easier to achieve. A manufacturer must, at any rate, ensure that the circuits of a frequency converter are immune to emissions made by the drive itself. Also, all complaints concerning frequency converters have related to emissions. Swedish immunity test results concerning frequency converters and our own immunity test results from UPSs, support the approach that immunity aspects are not a real problem for power electronic equipment on market.

The first tests were performed inside a shielded room at a measurement distance of 3 m. In many cases, not all accessories were sold with the frequency converter which had been mentioned in the equipment installation instructions. In this first testing period, test connections were made only with accessories which were retailed with equipment. In this way, we discovered the EMC ability of the equipment in a situation in which extra accessories had not been obtained and which is felt to be the most realistic installation set-up.

Only 10 frequency converters out of 24 passed the 3 m tests. There were serious defects found in 8 units (excess more than 10 dB above the limits of the test standard). Minor defects (excess less than 10 dB) were discovered in 6 units. Test connections in 3 m tests were made with accessories delivered with the unit. In many cases, there were no accessories or the wrong accessories were delivered with the unit. However, the missing accessories were generally mentioned in installation instructions.

Two converters with serious defects were not re-tested by TUKES. The importer had made simple mistakes with the housing of these models and these were clearly identifiable. Soon after,

the importer and manufacturer organised re-testing and mistakes were consequently rectified. Six frequency converters with serious defects were re-tested inside a shielded room at a measurement distance of 10 m. In this second test period EUT was installed using all the accessories mentioned in the operating instructions. Three re-tested models exceeded threshold values considerably and we concluded to give sales bans to these three models. With minor defects, we gave a caution to importer and manufacturer, in which we recommended manufacturers to notice our test results and to develop their products in order to achieve better compliance with harmonised standards.

Frequency converters have become more common, likewise complaints about emissions caused by them have increased. The high switching frequency and fast switching of large currents, which are characteristic of AC drives, inherently cause emissions. Typical disturbances caused by a frequency converter are due to incorrect design and installation. Such problems can be avoided when both the converter and the system utilizing it comply with the requirements of the EMC Directive. In the design and planning, attention must be paid to the installation method and placing. Earthing, protection and filtering are also critically important.

Only about 40 % of tested units met standards when they were installed using accessories delivered with the unit. Even though the test results were quite bad, it is not impossible to obviate disturbances from AC drive systems. In most cases, manufacturers can offer good filters designed for frequency converters and emission problems can be solved using proper installation methods. The installation of a frequency converter must be undertaken in accordance with the installation instructions. In some cases, manufacturer's recommendations are unclear or impossible to follow. Especially, according to Swedish results, there were lot of faults in installation instructions. Installation instructions should always be clear, even for skilled, professional installers.

In most cases, the correct accessories were not retailed with the frequency converter. Manufacturers and importers should take care that when selling frequency converters to customers, they deliver all mentioned accessories or, at least, inform of what accessories are needed in order to get the drive in conformity with standards. The new version of EMC Directive[xxxvii] is having that kind of requirement, too.

6.3.4 Publications [P7]

Unlike the generic EMC standards and most of other product family standards, EN 55015 [xxxviii] contains no requirements for radiated emissions from 30 MHz to 1 GHz. The Swedish Authority

[xxxvii] EMCD 2000.8 Working Document, which contains the result of the discussions during the meeting of the EMC Working Party on 6-7 March 2001, European Commission, Enterprise Directorate-General.
[xxxviii] EN 55015:2000 (CISPR 15:2000) "Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment". (Predecessor EN 55015:1996).

has found that at least some halogen lighting sets which are powered by an electronic transformer cause radiated emissions in frequencies not covered by EN 55015. When they tested two different electronic transformers according to generic standard EN 50081-1 [xxxix], they found that the apparatus exceeded the limit by 30 dB and 31 dB respectively at the same frequency 30.72 MHz, and the disturbance level was extensive up to 50 MHz.

Prior to the EMC market surveillance project on lamps in 2001-2002, TUKES had ordered tests for 13 energy-saving lamp models. Results showed that 5 models failed. 3 failed with over 10 dB and for them TUKES was forced to issue a sales ban. Energy-saving lamps have been tested in Sweden too. Between the years 1999 and 2000, the Swedish Authority has notified 8 energy-saving lamp cases according to the safeguard clause procedure of the EMC Directive. In these 8 cases, the measured excesses were from 9 to 21 dB.

The aim of the project was to find out the conformity of energy-saving lamps and to discourage non-conforming products from entering Finnish and EEA markets. Also, the adequacy of the standard EN 55015 with regard to the conformity of energy-saving lamps within the terms of the EMC directive was evaluated. Four halogen floor lamps were tested and analyzed as a point of comparison.

There were altogether 180 lamps purchased for testing; five samples of each 36 lamp-model. The test procedure commenced with the conducted disturbance test. First of all, one lamp from every five lamp sample was tested at random. If the disturbances were below the limits of the standard to an extent greater than the measuring uncertainty of the laboratory, the product was deemed to have passed the test. In such cases the other samples of that lamp type were not tested.

In the cases where disturbances were within measuring uncertainty range or above the upper limit of EN 55015:1996, the other four samples were tested. These four lamps were tested only in the frequency ranges where limits were overrun in the testing of the first sample. Following this, the statistical method for evaluating was used to determine the compliance of the product. The test results of the five lamp samples were calculated according to EN 55015 with the 80/80% rule.

Ten lamp models with results near the limits of the standard, or that had only minor defects, were selected to undergo a magnetic disturbance; a loop antenna test. At this stage, all five lamps of every lamp model were tested.

After the market surveillance tests, 25 lamps of the same lamp collection were delivered to undergo radiated interference testing. The emission tests were performed according to the standard

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[xxxix] EN 50081-1:1992 “Electromagnetic compatibility – Generic emission standard. Part 1: Residential, commercial and light industry”. *NOTE: Superseded by EN 61000-6-3:2001 “Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments”.*

EN 55022:1998. These tests were performed in a semi-anechoic shielded room at a measuring distance of three meters. The EUT was placed in the plastic lamp stand at a height of 1.15 m, on the turntable. The length of the power input cable was 1.50 m. If no defects were found, then only one lamp of each sample was tested.

In January 2002, EMC market surveillance tests for four halogen floor lamps were carried out. These floor lamps were equipped with one dimmable up-light halogen of 300 watts and one dimmable spotlight of 40...50 watts. Two models had a 12 VDC spotlight halogen, so in these cases also a transformer was used. Conducted disturbances were tested according to EN 55015:1996. Harmonic current tests were carried out according to EN 61000-3-2:1995 [xl] and flickers according to EN 61000-3-3 [xli]. From three floor lamps, radiated absorbing power from 30 MHz to 300 MHz was measured with an absorbing clamp according to EN 55014-1:1993 [xlii].

The test results show that 10 lamps out of 36 models did not pass the conducted disturbance test. There were serious defects found in three lamps. Surprisingly, defects were found to be equally distributed between inexpensive and expensive lamp models. In radiated magnetic disturbance tests, all 10 lamp-models easily passed the test.

EN 55015 contains no requirements for radiated emissions from 30 MHz to 1 GHz. According to our radiated interference measurements, this is not a problem in the case of energy-saving lamps, because all the tested lamps were more than 10 dB below the radiated emission limits of EN 55022. On the other hand, for halogen lighting sets powered by electronic transformer, radiated emissions might be a serious problem.

All four halogen lighting sets passed the tests of conducted disturbances and flickers. In radiated absorbing power testing, all three tested pieces of equipment easily passed the test. Instead, in harmonic current testing, serious defects were found in every tested halogen lighting set. At a certain dimming, all odd harmonic currents up to the 39th from every dimmer unit overran the limits of Class C of EN 61000-3-2. The total number of dimmer units was seven; three samples contained two dimmers each, and a set, one.

Seven halogen lighting set types have been notified about according to the safeguard clause procedure of the EMC Directive in 1999-2001. In all these cases, overruns of standard limits took place in disturbance voltage testing; from 12 dB to 37 dB. In Finland, two halogen sets were tested

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[xl] EN 61000-3-2:1995, superseded by EN 61000-3-2:2000 ”Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)”.

[xli] EN 61000-3-3:1995 ”Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection”.

[xlii] EN 55014-1:1993 (CISPR 14-1:1993), superseded by EN 55014-1:2000 (CISPR 14-1:2000) ”Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission”.

before the four cases described in this paper. In the prior tests, one set passed and the other had slight defects. The four halogen sets we tested in 2002, fulfilled all the other testing, but they had enormous difficulties with harmonic currents. According to measurements made by Swedish Authority, halogen lighting sets powered by an electronic transformer might cause radiated interferences. By absorbing clamp measurements, we did not find any notable radiated absorbing power values.

The observation of the project was that more and more of energy-saving lamp models are manufactured in the Far East. The same lamp model might be manufactured by several factories, and on the other hand, actually the same product might be offered for sale under different brand names. For example, a brand name owner for some energy-saving lamp models told us that if some of his lamps are found to be non-compliant, then he ordered the next production run of that lamp model from some other Far Eastern factory. A serious problem seems to be that the energy-saving lamps originating from the Far East do not have uniform quality and quality can vary a lot between production runs.

An open European market makes the import business easy. It also tempts unskilled businessmen with dreams of big profits, and they usually do so-called 'one-off' business deals. They import a few containers of products from the Far East, distribute them quickly on the market, and then disappear. Such kinds of business change the price structure of the market, which impedes the operation of those importers who take care of their reputations by being responsible businesspersons.

Decisive factors for the safety and conformity of a product are the first controls made by the manufacturer and the carefulness and sense of responsibility of the importer. An experienced and responsible importer can have an especially big influence on the quality of products imported from the Far East. The high number of lamp and luminary manufacturers in the Far East leads to competition between factories. There is a ready buyer's market and factories are prepared to do nearly anything in order to keep their clients satisfied. It became apparent from project interviews that the importer himself could mar the quality of products e.g. through over bargaining the price down too much. For example, not all importers learn to respect the emotive feelings behind Chinese business culture which does not permit them to be negative or say no!

6.3.5 Discussion of Publications [P4] – [P7]

During the market surveillance period, a total of 370 product types were EMC tested in Finland. Of them, more than half of the tested products satisfied the standards, about every fourth had small defects, and approximately 15 % had significant defects. However, there were great differences

between equipment groups, as shown in Fig. 6.7. In the UPS project the percentage value of fulfilled samples was 35 %, in the PC project only 8 %, in the frequency converter project 42 %, and in the energy-saving lamp project 72 %. PCs are clearly the most problematic group, the second being power electronics.

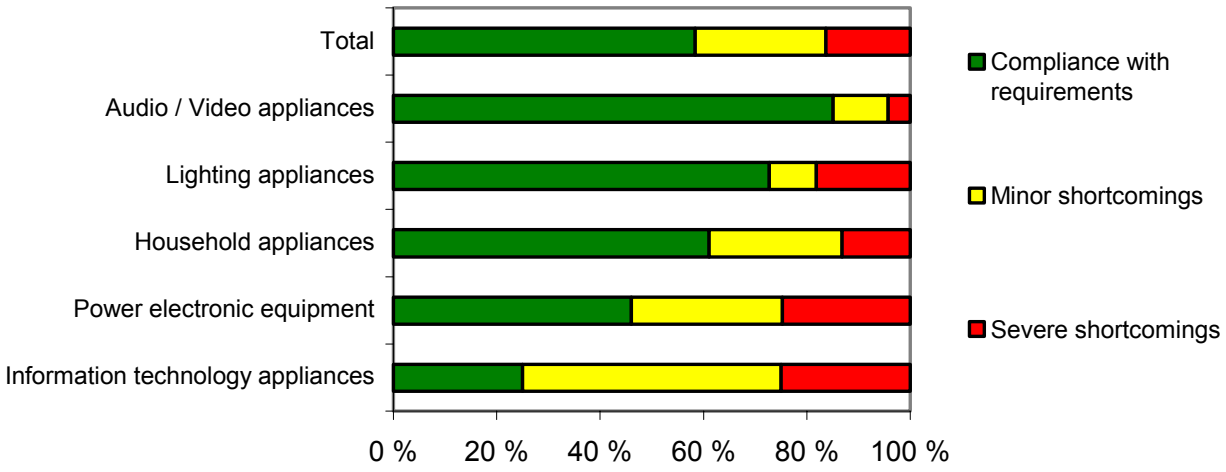


Fig. 6.7 The total results of TUKES's EMC market surveillance tests by equipment group.

The energy-saving lamp project showed that lamps might cause interferences, especially conducted RF emissions. Standard EN 55015 is a special standard for lighting that has served the market well for many years, but in recent times the incidence of interference from lighting has increased [Ker02]. This has coincided with technology developments in the lighting industry. With the increasing pressure for more energy efficient lighting and because of requirements for energy labelling of household lamps [xliii, xliv], there will be an increase in the use of technologically advanced lighting. It is therefore important to identify the possible cause of EMI, and if necessary update the standards to ensure that they fulfil their purpose in keeping EMI at an acceptable level [Ker02]. According to [Ker02], there is a need to improve the standards regarding electronic transformers used for low voltage lighting as was confirmed by the Swedish Authority measurements. In the VHF bands the luminary size causes it to act as an antenna [Ker02]. Hence, there is a need to develop suitable emission limits in the VHF bands.

Generally results show that emission problems are significant in power electronics devices. When comparing Swedish and Finnish frequency converter results, it can be noticed that there were more defects (<10 dB) and serious defects (>10 dB) found in Sweden. Also Finnish UPS test results

[xliii] Commission Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps.
[xliv] Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances.

[P4] were worse than Finnish frequency converter results [P6]. The UPS project was performed in 1997 and converters were tested in Sweden during 1996-1999. Obviously the EMC characteristics of power electronics have advanced during four years. Radiated emission is the most common defect according to these results. According to Swedish results, immunity is a much smaller problem than emissions for frequency converters. Finnish UPS test results support that conclusion.

The increasing use of frequency converters together with motors for e.g. lifts, ventilation and pumps has resulted in an increasing number of harmful interference sources for radio services. The emissions from power drives are a combination of broadband noise (commutation notches from rectifiers) and comb patterns from switch circuits [Ver02]. Most of radiated emissions come from the motor cable – the connection between frequency converters and the motor. In most cases, a good quality shielded motor cable which is well terminated at both ends, can rectify problems. The interference potential of power drives used in the residential environment is very high as the drives may operate constantly or intermittently, and the distance from the drive and cables to the receiving antenna may be very short [Ver02]. The EMC standard for adjustable speed electrical power drive systems IEC 61800-3 [xlv] is under revision and the new standard may solve some of the problems in the future.

6.4 Statistical analysis of the TUVA database

6.4.1 Publication [P8]

Fig. 6.8 shows that electrical safety market surveillance findings have changed over the years. Improvements could be seen as early as 1996. Then a fall in sales and delivery bans for safety reasons could be noted.

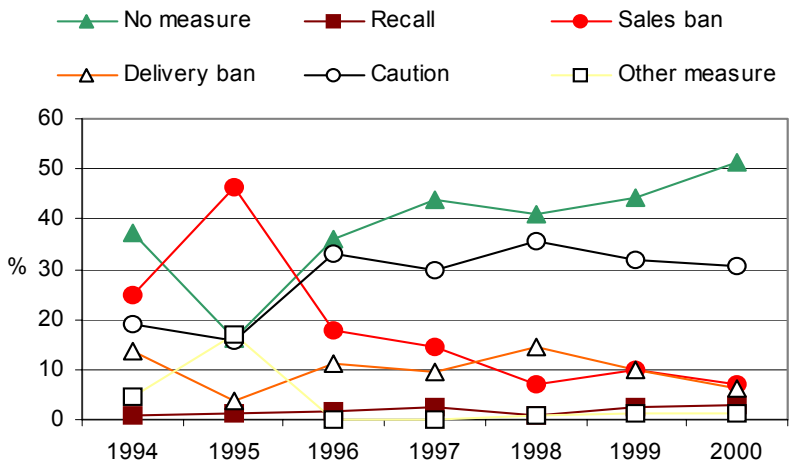


Fig. 6.8 The division of TUKES's safety surveillance measures over a six-year period (n=8934).

[xlv] EN 61800-3:1996 "Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods".

In the period 1994-2000, TUKES had 364 EMC market surveillance cases. 64 EMC market surveillance cases were from the 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.

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 generalised. However, for finding reasonable and comparable statistical results, the number of groups is too large (24). For this reason, the groups have been rendered down to 13, as shown in Fig. 6.9. Most of TUKES's market surveillance cases relating to electrical safety, specifically relate to luminaries and light fittings (SGS Fimko's device group T; 25 %). 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, had to be used most usually within the BQX-group (ITE etc.); 7.2 % of all tested products within this group came under this measure. From all the recall-cases that TUKES has instigated, almost 50 % were concentrated in the BQX-group. On the other hand, the number of sales and delivery bans was not high within this group.

In [P8], the term *degree of discovery* accuracy means the share of cases, which have led to some measure being taken by TUKES, compared with other logged cases. 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 (luminaries etc.). 41.6 % of the cases within this most monitored group led to severe measures. The number of cases which led to no measure being taken are located in groups AN, EHF and G. The percentage of tested products which comply with safety requirements was 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 did not lead to any measures being taken. Also, the proportion of severe measures was smallest in these two groups, together with the PCU-group.

Device groups	Items	n	%
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
TOTAL		**8402**	**100.0**

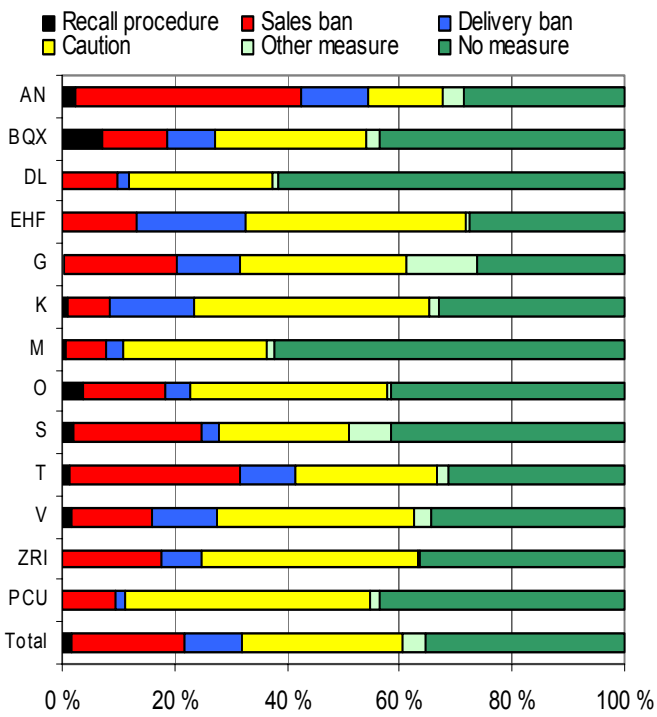
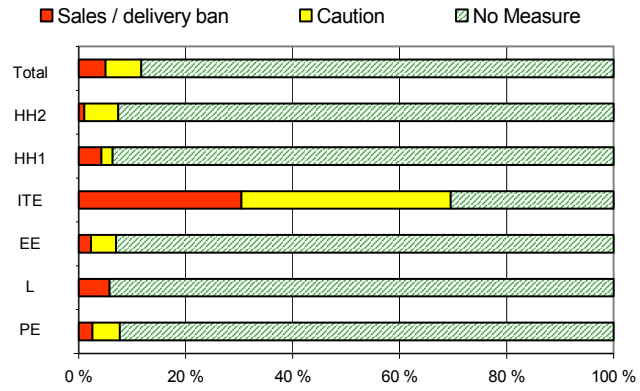


Fig. 6.9 The division of TUKES's safety surveillance measures divided into the device groups of tested products (n=8402).

When studying EMC surveillance findings, the applied device groups are also based on SGS Fimko Ltd's groupings. However, a slightly different make-up of combined device groups is reasonable to consider. In this study, only the cases, which were effective when the EMC Directive was mandatory, have been studied. Applying this grouping, most of the EMC market surveillance cases belonged to the **h**ouse**h**old (HH) 1 group; over 30 %. The share of other groups was about 15 %, except for the share of IT equipment that was 8 %. Fig. 6.10 shows the proportion of cases that have led to measures being taken. Although the grouping was approximate, 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 ITE led to a caution or sales/delivery ban. From all TUKES's EMC measures, almost 50 % were concentrated in the ITE-group. Within all other device groups, the proportion of measures was clearly below 10 %.

The handling of safety cases has speeded up and become more stable in its all components over time. Today, a typical safety case takes 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 for this study. When comparing safety cases leading to different measures (see Figure 6.11), it can be seen that the more serious the measure, the more protracted the case duration. On the other hand, the testing time has 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 %.



Device groups	Items	n	%
Total		300	100
HH2	Hair, skin, body care / Food and drink processing, heating and storage equipment / Cleaning and sanitation / Clothing care	95	31.7
HH1	Animal husbandry, insect prevention / Electrical tools and machines / Heating, plumbing and air conditioning	47	15.7
ITE	IT equipment	24	8.0
EE	Entertainment electronics	43	14.3
L	Lamps and luminaires / Switch-ing control and regulating devices	52	17.3
PE	Power supplies and components	39	13.0

Fig 6.10 The division of TUKES's EMC surveillance measures divided into the device groups of tested products (n=300).

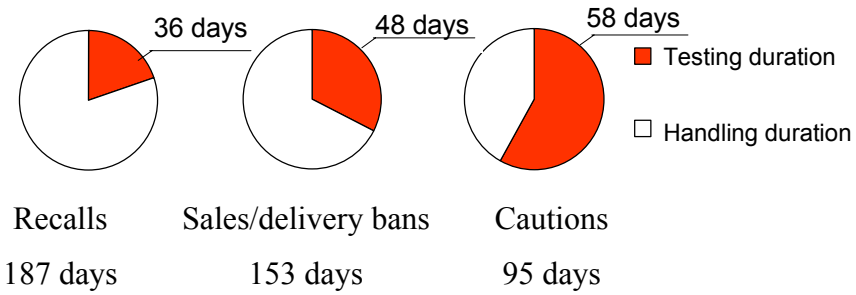


Fig. 6.11. Segmentation of LVD market surveillance case durations separated into different measures (presented durations are mean values).

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 was not established for gathering up statistical data, this study showed that the database could also be applied as a major source of statistical study.

According to the annual statistics study, the slightly increasing segment of market surveillance cases relating to electrical safety do not lead to any measures being taken. This also indicates that 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 dispersed quite reasonable among different device groups, although, the intensity of EMC surveillance could be especially 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

requirements are too lenient, market surveillance will have no tools or teeth for stopping entry of hazardous products onto the market at this time.

6.4.2 Publication [P9]

Between the years 1991 and 2000, FICORA registered 3,723 cases of interference to radio systems. 603 (16 %) interference cases were found to have been caused by electrical equipment. FICORA has divided statistics into three categories with regard to interferences caused by electrical equipment: information technology (IT), industrial, scientific and medical radio-frequency equipment (ISM) and 'others'. ISM equipment is identified according to EN 55011. The distribution of these categories is shown in Fig. 6.12. The same groupings have been applied throughout this publication.

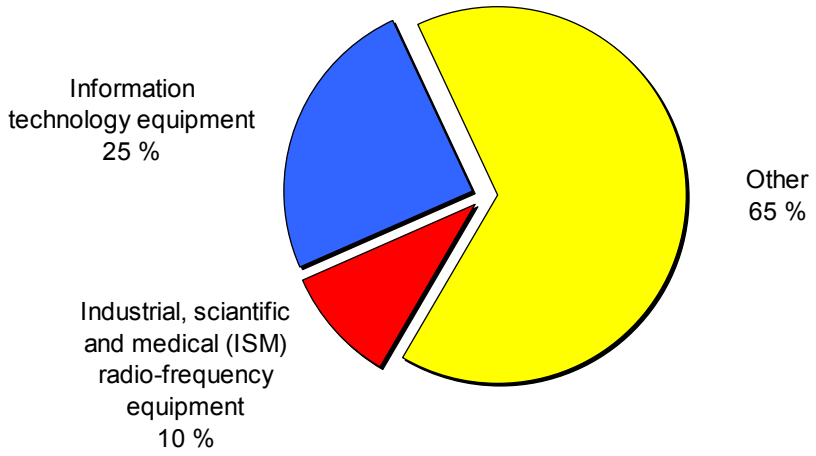


Fig.6.12 Graphical segmentation of FICORA's interference statistics 1991-2000, interferences caused by electrical equipment (n=603)

Between 1992 and 2001, the costs of radio monitoring equipment (measuring equipment and monitoring vehicles) have been 968,832 €. In future, annual measuring equipment investment costs will be about 100,000 €; this sum could double some years if any special equipment has to be purchased. 95 % of the usage time of measuring equipment is used for the monitoring of radio communications and radio interference problem solving. 5 % is used for market surveillance purposes. In 2000, FICORA's radio monitoring personnel costs amounted to 993,378 €. Of this sum, 15 % went to the monitoring of radio communications, 68 % to the clarification of radio interference, and 17 % to market surveillance. About 2 % of FICORA's market surveillance is EMCD related and about 98 % is related to the R&TTED.

Digita Ltd. is the sole nation-wide broadcasting company responsible for radio and television broadcasting in Finland. Digita Ltd. gives information to the public when television and radio transmissions are not seen or heard normally or there are interferences. When necessary, their

experts give advice in matters relating to e.g. the technique of positioning antennas, digital television and digital radio. According to Digita Ltd's statistics on radio systems, there were 13,293 recorded interference and other causes of complaint between the years 1991-2000. 722 (5.4 %) of all interference and complaint cases were caused by electrical equipment. Cases relating to electrical equipment have been defined in Fig. 6.13. It has not been possible to gain information relating to Digita Ltd's interference problem solution costs.

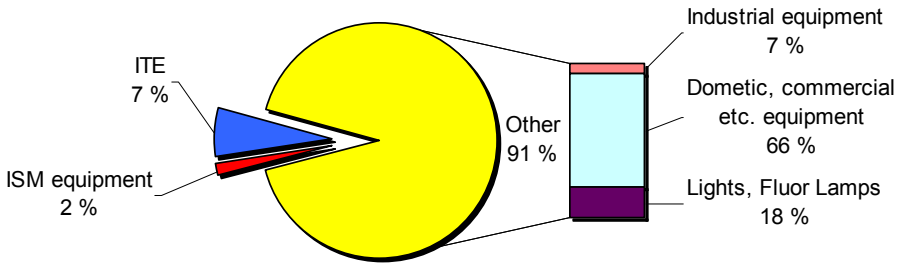


Fig. 6.13 The segmentation of Digita Ltd's interference statistics 1991-2000, interferences caused by electrical equipment (n=722)

TUKES's EMC market surveillance statistics shows that during the period 1994-2000, 296 products were selected for EMC testing. The distribution of EMC tested products is shown in Fig. 6.14. Groupings in this section have been made according to the EMC emission standard, which is mentioned in SDoC. Groupings are as follows: Industrial, Scientific and Medical (ISM) radio-frequency equipment ~ EN 55011, IT equipment ~ EN 55022, Lighting equipment ~ EN 55015, Industrial equipment ~ EN 55081-2 [xlvi], Domestic ~ the rest, mainly EN 55014-1.

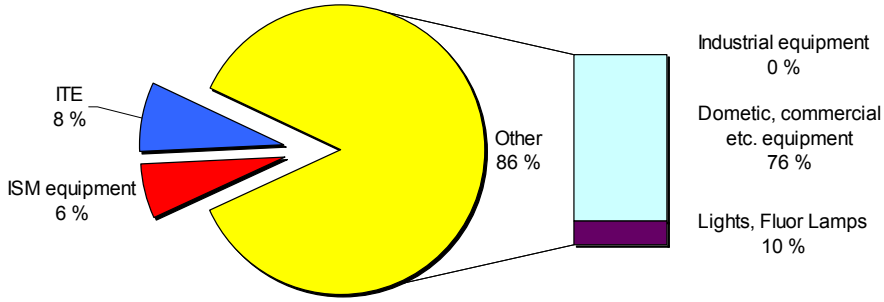


Fig. 6.14 The segmentation of the subjects of TUKES's EMC market surveillance 1994-2000, tested products (n=296)

From the tests, 139 (47 %) of products had shortcomings identified. Out of 139 instances, 56 cases led to various measures being taken. Fig. 6.15 shows the percentages of TUKES measures in product categories.

[xlvi] EN 50081-2 "Electromagnetic compatibility – Generic emission standard – Part 2: Industrial environment". *NOTE: Superseded by EN 61000-6-4:2001 "Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments".*

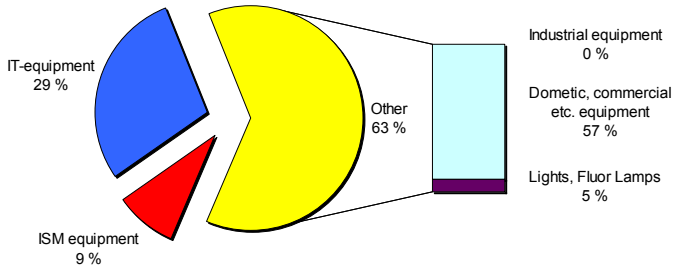


Fig. 6.15 The segmentation of the subjects of TUKES's EMC market surveillance 1994-2000, measures taken (n=56)

In 2000, EMC market surveillance test costs were 31,346 € and the purchasing costs of EMC tested units were 13,957 €. The employee unit costs for TUKES's staff were 40,191 €. EMC market surveillance was carried out by one full-time employee, furthermore six employees spent about 10 % of their working time on EMC market surveillance. So, the total cost of EMC market surveillance was about 110,000 € in the year 2000. The purpose of EMC market surveillance is to prevent electromagnetic disturbances. In 2000, FICORA's costs relating to the clarification of radio interference were about 768,000 €, which was about seven times bigger than TUKES's EMC market surveillance costs. Furthermore, radio interference problem solving had caused notable costs, at least, to Digita Ltd.

When different statistics are compared to each other, it can be noted that FICORA's interference statistics (Fig. 6.12) and TUKES's EMC market surveillance measures (Fig. 6.15) are statistically equally distributed within these categories of electrical equipment (chi-square-value 0.52 ~ p = 0.77).

Comparisons between Digita Ltd's statistics and those of other involved bodies show no statistical similarities. Still one has to note that some correlation between Digita Ltd's statistics and the products selected for EMC market surveillance testing (Fig. 6.14) can be seen when industrial equipment is moved into the ISM category, as in Fig. 6.16. Then the chi-square-value is 3.01, which gives the probability of 0.22.

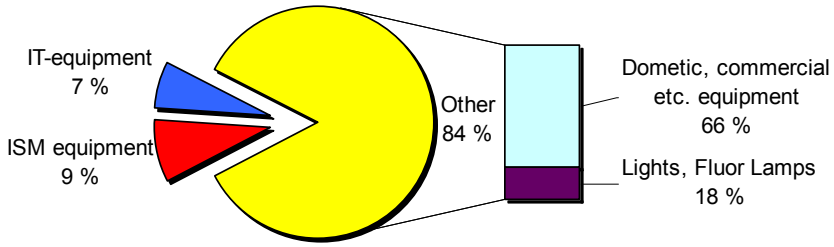


Fig. 6.16 The segmentation of Digita Ltd's interference cases 1991-2000, interferences caused by electrical equipment after industrial equipment had been transferred into the ISM category.

6.4.3 Discussion of Publications [P8] – [P9]

According to [RPA02], the average number of EMC complaints the authorities of the EEA countries received in 2001 is around 2,400, but there is considerable variability between countries ranging from zero to 19,000 (estimated total of around 35,000 across the EEA). As [P1] stated, the interference cases reported to Finnish EMC authorities (FICORA and TUKES) is a little more than 300 cases per year, which is quite a low number. However, in Finland, most interference cases with regard to TV and radio broadcasting are directly complained about to Digita Ltd, which annually receives more than 1,300 complaints. In the EEA, the main causes of interference are identified as domestic appliances, IT equipment and telecommunications apparatus [RPA02]. In Finland according to Digita Ltd's statistics, the main cause of interference is the electrical power supply together with traction networks, the second being electrical equipment in which domestic appliances are the main source of interference.

The level of testing also varies greatly between the EEA countries. Three EMC authorities responding to the questionnaire [RPA02] indicated that they undertook no testing at all, and of those EMC authorities that do undertake testing, the number of tests carried out varies between 5 and 4,750 per year. According to [RPA02], the mean value of EMC market surveillance tests carried out in every EEA country is 520. If reckoned without the maximum value (4,750), then the mean value is about 100 tests per year. In Finland, EMC market surveillance is divided between two authorities, and so, TUKES's annual 50-70 market surveillance tests could be considered to be a 'good' average number of executed EMC tests.

The study [RPA02] states that the annual costs of EMC testing vary between 3,600 € and 7.5 M€ amongst the EEA countries. The average (mean) cost of testing per product across all responding authorities is 1,800 €, ranging from 500 € to 6,300 €. There are differences between the products tested, with telecommunications networks, mobile radio equipment and aeronautical/marine apparatus having much higher testing costs. In 2000, TUKES's EMC market surveillance costs together with purchasing costs of the tested samples were about 45,000 € which indicates an average cost of about 700 € per tested product. TUKES's EMC market surveillance costs can be considered to be quite reasonable.

Unfortunately, good EU-level statistics of LVD market surveillance and their costs are not available.

7. Conclusions and Discussion

In this chapter, the main results of the work are summarized and lessons to be learned discussed. Also, the research questions given in chapter 2.1 are concentrated on, the scientific importance of the work is assessed, and scenarios and some interesting future research topics are discussed.

7.1 The Main Results and Lessons to Be Learned from the Publications

[P1]: According to TUKES's findings, continuous market surveillance has contributed towards a positive trend. When examining the results for the past five years, it can be clearly seen that the segment of non-compliant products has shrunk with each passing year. Along with more effective European market surveillance cooperation, more and more potentially dangerous products are being withdrawn from the market in those European countries where they are manufactured or imported into. With these facts in mind, today's market surveillance method is at least as effective as the previous obligatory pre-approvals system from the safety and EMC point of view. But, if TUKES hadn't had resources that it has had during its six years of existence, the situation would surely be totally different today. TUKES's market surveillance findings in 2001 indicated that the safety of electrical products has improved. According to TUKES's observations, manufacturers and importers of electrical products have increasingly invested more in assuring the conformity of their products. Also, the cooperation between European market surveillance authorities has become more effective, year by year. Fewer non-compliant electrical products are entering the Finnish market than previously.

[P2]: Decisive factors for the safety and conformity of a product are with the internal control made by the manufacturer and in the carefulness and good sense of responsibility of the importer. An experienced and responsible importer can have a considerable influence especially on the quality of products imported from the Far East. The high number of manufacturers in the Far East leads to tough competition between factories. There is a ready buyer's market and factories are prepared to do nearly anything to maintain client satisfaction. From the study [P2], it was apparent that the importer himself could mar the quality of his selected products through pushing for too keen a price for himself. It is clear that not all importers learn to respect or understand the emotive feelings behind Asian business culture which does not permit the native manufacturer or his agent to be negative or say no, and so they say 'no' by concealing it within lowered component quality.

The general conclusion of the study [P2] indicates that the market surveillance of electrical equipment in Finland operates well. In spite of this fact, dangerous products continuously find their way onto the market. Because Finland is a small market area, manufacturers are not interested in making products solely for the Finnish market. If market surveillance were effectively operational throughout the EU, manufacturers would be driven to invest more in the quality and conformity of their products. TUKES's methods and activities could be set as an example of a well-managed market surveillance system. It is reasonable to believe that improvements in only TUKES's own market surveillance would not reduce the number of dangerous products on the Finnish market. TUKES must strive towards and actively promote better and more effective EU-levels of market surveillance.

[P3]: Many entrepreneurs who have received sales ban(s) or other restrictive decisions criticise the conclusions TUKES draws regarding the dangerous nature/interference of products. It is difficult to improve TUKES's customer satisfaction level on these issues, since the view TUKES has of its activities differs very much from that of clients. It is, therefore, worthwhile considering whether TUKES can influence matters with its activities, or should the existence of disgruntled customers be considered as acceptable to a certain degree. However, most respondents in the study [P3] consider that market surveillance is necessary. Ten percent of them consider it to be unnecessary because they think that the EU already supervises and that domestic market surveillance is a pointless overlap. Although there were only 16 % of respondents who wanted more information about the principles of market surveillance in Finland and in the EU, it is clear that there is a serious misunderstanding in the belief that there is some form of independent EU market surveillance beyond the market surveillance carried out by Member States. Clearly more information about the current principles and state of market surveillance should be made available.

[P4]: A very common reason for failures in EMC market surveillance tests is that the products currently being manufactured are not the same as the products for which compliance with standards had been measured. Many times improvements and modifications have been made. Components may have been changed, wiring is sometimes rerouted, or connector types have been changed. In many cases, such design and manufacturing improvements do not equate to improved EMC. An accepted test report or certificate is worthless if the product has been modified since its original testing.

[P5]: Today's market surveillance system and its measures, such as sales bans, are not suitable for the supervision of products 1) for which production time is only for a few months, or 2) which are not serial products. In these cases, products that receive restrictive measures are

not any longer on the market at the time of the measure. Also, the conformity assessment requirements issued by the EMCD are not fully applicable to non-serial products.

[P6]: Equipment which has varying safety and/or EMC characteristics due to being installed or used perfectly precisely is very difficult for market surveillance authorities to survey. The market surveillance authority has no resorts to deal with a manufacturer who states that he 'knows' his equipment and has managed to set sufficiently limiting norms so as to make so called 'correct' installation or use so restricting that an installer or end-user has real problems implementing over-demanding safety or EMC instructions. In fact, in the real world, hardly any installer or end-user follows such instructions, with the result that clever manufacturers can always lay the blame for problems on the incorrectness of installation or use and never on the product itself. The Authorities' only way to affect the situation is through tightening harmonised standards and in doing so, hopefully closing loopholes.

[P7]: From a market surveillance authority's point of view, it is very problematic that the quality of products varies so much between production runs. For example, energy-saving lamps are a question in point. The researcher has noticed that the quality of inexpensive, in general Far Eastern made, products can vary extensively. After TUKES has placed a sales ban on a 'bad' production lot, the importer shows that the products have been altered and that now the product type is, to his mind, acceptable. Following this, TUKES then gives permission for that product type to be sold. But, who knows what kind of products the next production run might carry!

[P8]: 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 also indicates that the number of non-conforming products on the Finnish market is declining slightly. ***The device group study*** shows that the market surveillance of electrical products is focused quite reasonably 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 handling of market surveillance cases has 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, because e.g. recalls normally need advertising in papers and magazines to withdraw sold products from consumer hands.

[P9]: In Finland, the annual cost of EMC market surveillance is considerably lower than the cost of radio interference problem solving. It would be worthwhile for TUKES to consider the developing trend of FICORA's interference cases when planning for the volume of EMC market surveillance testing, e.g. in budgeting, etc. When comparing interference statistics and EMC market surveillance figures, two main conclusions can be drawn: 1) The products TUKES selected for EMC market surveillance tests represented the same product categories, which caused interference to radio and TV broadcasting. 2) The complaints FICORA received concerning interfering electrical equipment, correspond surprisingly well with the equipment groups which have received the majority of EMC market surveillance measures. To date, TUKES has not applied Digita Ltd's classification system for sources of interference and other causes of complaint when administering EMC market surveillance. Still, some similarities between allocations can be seen. One might draw the conclusion from the comparison of statistics that TUKES has succeeded in selecting EMC tested products with the intention of removing non-compliant products from the market. In future, Digita Ltd's detailed classification of sources of interference is worth benefiting from when applying EMC market surveillance resources.

7.2 Does Today's Legislation Ensure that Electrical Equipment Has Conformity and Is Safe?

As mentioned in Chapter 3, the New Approach has made a big contribution to the single market's success in recent years, by enhancing the safety and performance of industrial products whilst ensuring their free movement throughout the EU. It works by laying down only essential safety and/or environmental requirements, and by allowing entrepreneurs to find the most appropriate technical solutions to meet them, often by working to agreed European standards that are readily adapted to technical development.

A general problem for NA directives seems to be their non-uniformity which is based on long individual traditions in different technology fields. This indicates that, also, the parallel application of several directives for a single product is not always trouble-free. At least, the following EU-level rules are missing: [1)] clear executory statutes of market surveillance for every NA directive, [2)] effectivity requirements/targets for market surveillance, and [3)] how and to whom expenses should be allocated in cases where a non-compliant product is found on the market.

The greatest problem in applying NA directives is the standardisation (excluding the fact that some member states seem to neglect their responsibilities in carrying out market surveillance). For

example, with regard to EMC standards, their technical contents do not always answer the need for EMCD (see [P4]-[P7]), the number of standards is too large, and their clarity and readability, as well as their availability, should be better. Even though the tradition and history of EMC standards is fairly long, the electrical and electronic industry seems to consider EMC standards as including useless requirements. Immunity standards especially, have requirements which can be considered to bee more quality matters than essential protection requirements laid down by harmonised standards. The use of EMC standards for conformity assumption of the EMCD's essential protection requirements is still a new thing, especially, with regard to the general slowness of the standardisation process. EMC standards have not yet been adapted to the serving of this matter. In contrast to this, irrelevant requirements have been reduced in safety standards for electrical equipment, because the LVD has already been in force for about three decades. On the other hand, as stated in [Nur01], fire hazards are still a noticeable open problem in some standards.

The ongoing reviews and revisions of the LV and EMC Directives are expected to benefit market surveillance authorities with the easier identification of products through the new information requirements. This will hopefully amend the situation with regard to identifying the 'bad' production lots discussed in the context of [P7]. The renewal of the EMCD will change the need for a report or certificate from a 3rd party into being voluntary in cases when harmonised standards have not been fully applied. This will help the conformity assessment procedure of customised, non-serial products which is a problem which arose in [P5]. However, this proposal change for the EMCD, will not assist the suitability of market surveillance systems for non-serial products. According to [RPA02], this proposal change will also lead to [1)] authorities requiring more technical expertise and knowledge of circuit construction and EMC-related equipment and systems design; and that [2)] more detailed juridical expertise and knowledge of EMC standardisation policy will be necessary for coping with ongoing court cases.

In Finnish electrical safety reform, the introduction of LVD and EMCD meant the abolishment of the advance approval system by replacing it with market surveillance. According to [Sim99], post-control by authorities does not fully prevent dangerous electrical equipment and materials from entering the market because controls concern products already on the market. TUKES's findings support this observation. Reference [Sim99] also says that in Finland as well as in Denmark, where they have the most experience of market surveillance, the situation would appear to be stable and no noticeable deterioration or improvement has taken place as far as electrical accident statistics are concerned. Also, the tendency shown in Swedish market surveillance statistics confirms this.

Since products subject to TUKES's enforcement have caused no serious accidents during recent years as demonstrated in [P1], the general safety and EMC level of products can be

considered to be good in Finland, even if there is a need for improvement in some areas. This indicates that the New Approach with suppliers' self-certification and effective market surveillance within the extensive operations of the EU is at least as good a system as the previous pre-approval one with regard to electrical equipment. With the increase of customised products it would not be at all sensible for authorities themselves or testing laboratories with their mandates, to carry out advance testing for all different types of products. Also, the points made in [P4] go towards supporting this conclusion. Products which cause problems are in many cases changed during production and are different to those which were originally 'approval' tested. In this situations the obligatory pre-approvals system does not give any added value. As well as this, both the fatal accidents which occurred in Finland and were caused by electrical equipment, supported this latter argument. The standard lamp which caused an infant's death was manufactured at the time of the obligatory pre-approvals system. The fatality caused by a welding unit was in fact caused by incorrect use, outdoors in the rain, when it was intended for only indoor use. It was also found to have been damaged prior to the accident.

The main task of market surveillance is to supervise seeing that the 'system' works and that all parties involved carry out their appropriate roles. It is not intended for the surveillance of individual products. If all parties recognise their responsibilities and follow the rules and instructions of the system, it will most certainly work. It could be summarised that the NA together with SDoC is a very good principle but its harmonised standards and enforcement still need more resources and leaves room for improvement.

7.3 Is Finnish Market Surveillance of Electrical Equipment Appropriate for Today's needs?

Experience has made TUKES aware that the market surveillance which is demanded from it by legislation is hardly enough. The enforcement process is divided between market surveillance, clientship development, process planning and implementation. TUKES applies the principal of self-auditing to the development of all its processes and tools. However, TUKES has no procedure established for managing processes in tandem with partners. Also, unfortunately the enforcement process does not include any systematic procedures for continuous learning, innovation and improvement. TUKES has produced several development projects. It has for example, prepared guides for electrical and lift safety. TUKES has developed testing methods with the cooperation of testing bodies and proposals for how to modify current standards so that they can offer increased safety to consumers. However, the application of performance results is deficient when TUKES is setting development goals and prioritising them for its own use.

TUKES produces services for different client groups in an established form, e.g. enforcement (Council of State); guides, information (subjects of enforcement); the appropriate safety and EMC level of products (consumers, citizens); information and development services (partner authorities). Communications and marketing of services occur via several channels: surveillance visits, written newsletters or brochures, phone assistance, e-mails, Internet and advertising campaigns.

The quantifying and assessment of the impressiveness, profitability, effectiveness, etc. of a market surveillance authority's operation is a very difficult task. It could be stated that good market surveillance must fulfil the principles of modern authority supervision. The Authority must be expert in the branch under supervision, and must be fully aware of the effects of different measures on all parties. Close cooperation between the Authority and industry and trade is of prime importance. For example, an entrepreneur's voluntary recall campaign often succeeds with better effect than coercive means do.

The principles of modern authority supervision, stated in Chapter 2, are taken into account in TUKES's market surveillance of electrical equipment and accessories in the following ways:

1. Proportionality to the risk— TUKES has the very strong and experience based belief that electrical shocks and electrical fires are the greatest risks from electrical products. For this reason, the market surveillance of electrical equipment is steadily focused on safety (LVD) surveillance. EMC surveillance utilises about 10 % of TUKES's electrical product market surveillance budget, and surveillance relating to energy efficiency regulations consumes about 2-3 %. In safety surveillance, the products to be tested are selected according to the following indicators which point towards potentially dangerous product groups: 1) the individual inspector's experience, 2) advance clues provided by test-laboratories, and 3) LVD notifications from other member states. In Finland, the number of electrical accidents caused by electric shock from electrical equipment is minimal. According to [P8], TUKES's market surveillance is reasonable well focused from the standpoint of causes of electrical fires. As indicated in [P9], TUKES's EMC surveillance is directed towards the product groups which according to the statistics, cause most recorded interferences.

2. Objectivity and consistency—TUKES's market surveillance of electrical equipment embraces all product categories (see [P8]). TUKES's inspectors visit itineraries cover all Finnish electrical appliance manufacturers, importers and vendors and include at least one visit every other year. All TUKES's reactive measures are in careful balance with the degree of seriousness of the findings obtained from test results. Although, some entrepreneurs who have received sales ban(s) or other restrictive decisions have questioned this point [P3]. However, on the scale of 1 to 5 used in [P3], the 3.1 grade can not be considered too negative a comment from those who received a serious

measure. A ‘caution’ received as high as 3.9 out of 5 in feed back and this can even be considered rather favourable.

3. The degree of discovery accuracy—TUKES’s field inspectors’ expert eyes are very often drawn towards suspect products during surveillance visits. They very seldom purchase unnecessary products for testing. Sometimes, good and perfect samples are also purchased for comparative reference, especially for market surveillance projects. Statistics in [P1], [P8] and [P9] show that the rate of discovery accuracy is good.

4. ***Are based on technical facts***—All TUKES’s measures are based on test findings and reports from accredited and independent test-laboratories as explained in [P1]. TUKES uses three laboratories for safety testing; one Finnish, one Swedish and one Norwegian. In the field of EMCs, three competent laboratories are also used.

5. Openness and transparency—TUKES’s decisions are public documents. The administrative process includes a hearing procedure, in which the documents proving the compliance of the product with the essential safety and health requirements of the directive can be provided to TUKES. In the hearing procedure, all relative information which TUKES has, is provided to concerned parties. With regard to openness and transparency in all areas, TUKES operates visibly in the field, giving information in a very timely fashion directly or via the media, to industry, retail and wholesale entrepreneurs and the public. TUKES’s information services were evaluated in [P3] and the respondents were most happy with them, but some critical feedback was given with regard to the availability of information.

6. Credibility—TUKES has resources to carry out field inspection visits, as well as to purchase and test products, as described in [P1]. In addition to this, TUKES has the right under law to apply measures at its discretion, e.g. sales bans (see Table 6.1). TUKES has a recognised reputation in Finland and abroad. In its relatively short life, it has gained many tributes, e.g. for media campaigns. It also gained ‘a distinguished mention’ from the *jury of the National Quality Award Competition 2001***,** in a new class open for public authorities and non-profit organisations.

7. International compatibility and reality—TUKES notifies all sales bans to the Commission of the EU and other Member States, according to the safeguard clause procedures of the LVD and EMCD. TUKES participates very actively in the Administrative Cooperation work group (ADCO), e.g. it held the chairmanship for the first meeting of the working group.

A conclusion can be drawn indicating that no exact methods for measuring the success of market surveillance’s operations actually exist. However, it seems that TUKES’s operation fulfils the main principles of modern authority supervision, although some points for development have

arisen, especially in the showing of objectivity and consistency in levels of supervision, as well as in proportionality to risk.

7.4 Proposals for Action

Publications [P1]-[P9] include potential development requirements and suggestions as to how to carry out the tasks with regard to the market surveillance of electrical equipment and the legislation supporting it. The proposals for action presented in this section are a summary of the most important points. They can be divided into four separate proposal categories: [I)] the developments required for the functioning of the New Approach, [II)] improvements in the LVD and EMCD, and their supporting standards, [III)] the evolving changes that should be carried out in Finnish legislation and [IV)] the growth of TUKES's own development.

I) Potential development requirements in the New Approach

1. For it to be effective, market surveillance has to be improved at EEA-level. This will mean that a very challenging period of work can be expected in Europe in coming years. The central goal should be to aim for a uniformly high level of enforcement in internal market legislation.
2. Market surveillance authorities need 'a non-conformity assessment policy'; rules and the means to show in what way a product does not fulfil the essential health and safety or protection requirements of directives. According to the NA, the conformity of a product can be proved by applying harmonised standards. Since the use of harmonised standards is voluntary, the contrary statement is not automatically correct; authorities cannot prove the non-conformity of a product by showing that it does not fulfil the requirements of harmonised standards.

II) Indications of weaknesses in the LVD & EMCD & their harmonised standards

1. The essential health and safety (LVD) or protection (EMCD) requirements of directives should be made clearer, so that the conformity or, from the market surveillance authorities' point of view, at least non-conformity with essential requirements, might be more easily assessed. The directives should be structured in such a way that they first indicate hazards and then related safety or protection goals. In addition, the directives should clearly show the appropriate measure countering the hazard, or if this is impossible, then directives should indicate the means or procedures for fulfilling safety or protection goals.

2. As stated in 7.2, the greatest problem in applying NA directives is that of standardisation and this is the situation with the LVD and EMCD, too. The harmonised EMC standards require a good number of fine adjustment for improvement, and some of these have been discussed in [P4]-[P7]. Fire hazards are still an open problem for some electrical product types [P1], [P2], [Nur01]. From a market surveillance authority's point of view, standards which prove non-conformity with a directive's essential requirements would be a very nice cause to work towards, even if it was against the understood principles of the NA. With the likely impact of the proposed regime for 'fixed installation' in the new EMCD draft, aren't we in fact, moving towards this direction? The requirement for testing in a complaint situation would lead to that kind of 'in-situ' EMC testing standard, which proves the fixed installation in question might or *might not* comply with the essential protection requirements of the EMCD.

III) How should Finnish legislation be updated with regard to electrical equipment?

1. In the cynical world, it would seem today that it might be more economically attractive and tempting to bring products to the market whose conformity has not really been properly assessed. This situation and attitude should be changed and of course, it should always be more profitable and rewarding to follow the safety and conformity rules.
2. TUKES should have the right to impose administrative measures, e.g. sales ban without having to identify technical shortcomings in cases where documentation or a lack of it shows the product as failing to meet the requirements of the directive. This would increase the credibility and functionality of TUKES's document control procedures. It would also improve the economic efficiency of market surveillance since the need to purchase and test products would proportionately decrease.

IV) How should TUKES's operation and market surveillance structure be improved?

1. As concluded in [P1], [P2], the best success in improving the safety and conformity of electrical products on the Finnish market can be gained through international cooperation. Especially, the continuation of active operations in the field's both Administrative Cooperation working groups (the EMC ADCO and the LVD ADCO) is of prime importance. TUKES should also actively participate in these directives' amendment processes.
2. TUKES's information services plays a great role and its importance is continuously increasing, e.g. with more global trade and growing e-commerce. From [P1]-[P9], it can be

concluded that in most cases concerning a non-compliant product, there is very often the manufacturer's or importer's lack of knowledge as to how to operate correctly, behind the problem; for example, not all Finnish importers appreciate the depth of cultural knowledge required for successfully trading in the Far East ([P2] and [P7]).

3. However, TUKES should not neglect its basic market surveillance work in Finland. And for improving it, TUKES might better take advantage of [1)] FICORA's and Digita Ltd's interference statistics [P9], and [2)] the statistical information potential gained from the TUVA database [P8].

The author's opinion is that the most effective way to prevent the appearance of more dangerous or non-compatible electrical equipment is to change legislation and general attitudes so that it should always be more profitable and rewarding to follow the safety and conformity rules, which is far better than trying to carry out the conformity assessment procedure at as low a price as possible.

Finland is a small market area and for this reason, global manufacturers are not interested in making products solely for the Finnish market. It is reasonable to believe that improvements in only TUKES's own market surveillance would hardly reduce the number of non-conforming products on the Finnish market. If market surveillance were effectively operational throughout the EEA, manufacturers would be driven to invest more in the quality and conformity of their products. The best way that TUKES can improve the safety and conformity quality of electrical products on the Finnish market, is to actively strive towards better and more effective EEA-levels of market surveillance, at the same time nevertheless, not neglecting its prime responsibilities in monitoring the Finnish market.

Today, goods flow around the world at unbelievable speed and consumers from many different cultures are purchasing the same products. In the long term, global safety and EMC requirements as well as their enforcement throughout should be the target to aim for.

7.5 The Scientific Importance of this Work

Market surveillance has finally become an integrated part of European conformity assessment policy. Enforcement organizations now exist in most of the member states and enormous pressure is being placed on all of them to make their enforcement organizations more effective. However, very little scientific research has been carried out in the field on market surveillance with regard to NA directives. This is the first time that such an extensive piece of market surveillance material with regard to electrical equipment has been researched.

The empiric part of the study includes four parts. The first one researches the Finnish market surveillance system for electrical equipment, applying qualitative methods. It shows that the EFQM criterions is a useful method for evaluating a market surveillance authority's operations and results, even though all criterions are not useable, as they stand.

In the second part, the operations of subjects of market surveillance were examined together with their thoughts concerning market surveillance. Ten importers were extensively interviewed and from an authority's point of view, a great deal of new information with regard to trade in the Far East was gained. Also, the importers' individual experience and experiences were found to be very enlightening. With regard to TUKES's market surveillance system development, rather little new information was gained, but the clear need for spreading information about international market surveillance and its extent, was clearly shown to be very much required. 'Client satisfaction' statements with regard to being the subject for the reactive decisions by a market surveillance authority, might be considered an audacious feat, but in fact, it proved to be a very acceptable method. It also produced many ideas for TUKES's development.

The project method proved to be a very suitable one with regard to EMC market surveillance. The project produced important information regarding the function of such a monitoring body as TUKES. It also brought to light problem areas in the field and possible failings or weaknesses in regulations and standards. In LVD enforcement, the project method could to be used more. Also, more 'cross-border' market surveillance projects should be encouraged and promoted further.

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 was not established for the gathering up statistical data, [P8] and [P9] showed that the database could also be applied as an excellent source and tool for statistical study. The electrical accident statistics do not provide much information towards focusing on LVD market surveillance. This is because fatal accidents are fortunately few and 'minor accidents' tend to go unreported. On the other hand, radio monitoring authority and broadcasting company interference statistics could benefit EMC market surveillance concentration on problematic areas.

By summarising the importance of this research, its results can benefit the evaluation and the development of Finnish electrical product market surveillance and its related legislation and help to focus communications so as to be more effective. It can be supposed that this research can have a positive impact on the safety and EMC correctness the electrical products on the Finnish market. Indirectly, this is because TUKES's operations will possibly become more effective and its resources better concentrated. The results have already been presented at international forums and

have gained interest from areas outside European circles. International interest has stemmed from [1] the effect and operatebility of the European Low Voltage and EMC Directives in Finland, and [2] Finland is recognised as being one of the pioneers in the enforcement of these directives.

7.6 Scenarios and Needs for Further Studies

There seems to be no end to the development of electrical equipment. The traditional electrical safety would seem to be quite manageable through using the tools which are available for managing electrical safety, although the possibility of electrical fires will not get any less. The future of the safety of electrical products is going to be in their functional safety. The electromagnetic environments around us change all the time. More and more products contain microprocessors and product safety functions are being integrated into the programmes found in the circuitry of today's and the near future's products. Wireless information exchange tools are becoming more common making the likelihood of disturbance activity even more likely and the risk of serious accidents and economical loss will also increase. Possible programme faults and EMC weaknesses will need more efforts in research, especially from the safety perspective.

Several factors may affect the success of the single market. The enlargements of the EU for the inclusion of Central and Eastern European candidate countries, are going to place more pressure on the market, creating a considerably increased need for market surveillance. One of the aims of product related legislation work is to create norms, within the limits of which the problems that come with technical development can be controlled. The development of global markets will have to harmonise product requirements and therefore safety and EMC regulation for electrical equipment will not remain a matter just within the EU. The effect of mutual recognition agreements (MRAs) on conformity assessment between EU and non-EU countries is a factor today. These agreements will probably create new challenges. For example, the MRA with the USA and Canada specifies that restrictions on the market entrance of products should be communicated to the authorities in the country of origin, requiring that the market surveillance authorities inform not only the EC but also the manufacturing country [Ett00]. These are problems and question which will have to be faced in the not too distant future.

Changes in the operational environment of safety and environmental compatibility surveillance had considerable influenced towards justifying the establishment of TUKES. As earlier mentioned, changes in the world and in development and technology will continue at an ever increasing pace at many levels. The challenges of change and development include among other matters the following: [1] The further development of the structure of central government (ministries, central government offices) and the development of services, have an influence on the Finnish market surveillance of

NA directives. [2)] New EC Directives now in force (pressure equipment, Seveso, etc.) and probable new directives on the way will increase TUKES's work load considerably. The increasing number of energy consumption marking regulations and the Energy Efficiency Directive will have a direct influence on the market surveillance of electrical equipment. [3)] New responsibilities which have been assigned to TUKES (rescue service equipment, construction products) will require adaptation to the requirements of TUKES's 'traditional' market surveillance operations. [4)] New technologies need new safety and environmental compatibility standards and, maybe, new surveillance structures. [5)] Changes in attitudes towards safety (environmental threats, terrorism, etc.) will most certainly effect to the emphasis between personal safety and environmental safety. [6)] Globalization (multinational companies, global markets) is converting the structure of world-wide trade and, so, TUKES's market surveillance 'clients' will be expanded. [7)] Increasing European integration and EU expansion will increase the administrative cooperation. [8)] Today, e-commerce certainly needs totally new market surveillance methods and, probably, information services for the public will succeed with better effect than traditional market surveillance does.

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Appendix B: Community legislation referred to in this dissertation

- Council Directive 73/23/EEC of 19 February 1973 on the harmonisation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits. Amendment 93/68/EEC.
- Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety; came into force 15 January 2002, must be transposed by the Member States into national law by 15 January 2004.
- Council Resolution on a New Approach to technical harmonisation and standardisation, 7.5.1985.
- Council Decision 90/683/EEC which was replaced and brought up to date by Decision 93/465/EEC.
- Council Decision 93/465/EEC of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures and the rules for the affixing and use of the CE conformity marking, which are intended to be used in the technical harmonisation directives.
- Council Directive 89/336/EEC of May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility. Amendments 92/31/EEC, 93/68/EEC (and 98/13/EC).
- Council Directive 99/5/EC of the European Parliament and of the Council relating to radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.
- Directive 98/37/EC of the European Parliament and of the Council of 22 June 1998 on the approximation of the laws of the Member States relating to machinery. Amendment 98/79/EC.
- Council Directive 88/378/EEC of 25 June 1987 on the approximation of the laws of the Member States concerning the safety of toys. Amendment 93/68/EEC.
- Council Directive 89/686/EEC of 21 December 1989 on the approximation of the laws of the Member States relating to personal protective equipment. Amendments 93/68/EEC, 93/95/EEC and 96/58/EC.
- Commission Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps.
- Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances.

Appendix C: Errata

[P1] - Figure 9 *should be replaced with* Figure 6.4 in this dissertation.

[P2] - Reference [2] *should be rewrite* "[2] J. Rajamäki and A. Kasanen, 'An EMC Market Surveillance Project on Energy-Saving Lamps in Finland', in *Proceedings of the Sixteenth International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility*, Wroclaw, Poland, June 2002, pp. 573-578.

[P9] - On page 161, above Fig. 9, the word "probalility" *should be replaced with* "probability".