Geographic Information Quality Management and Standardization in Finnish Defence Forces

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SUMMARY

The main issue in Geographic Information Quality Management (GIQM) and standardization is to achieve interoperability through standardization. This still ongoing research project defines a quality model for geographic information in Finnish Defence Forces (FDF). The quality model is strongly based on international ISO standardization. The quality model defines a basis for consistent concepts and methods for GIQM. FDF quality model defines data quality elements, data quality measures, quality evaluation procedures and reporting of data quality. Quality model is enhanced with NATO Standardization Agreements (STANAG). Principles defined in quality model are applied in data purchase and quality control processes in FDF. Quality management in general is coordinated operations to steer organization and operations concerning quality. The principles of quality management are defined according to ISO standardization. The quality of geographic data and cartographic product is defined as a degree how requirements are fulfilled. Data quality is investigated separately from the geographic data and cartographic data product point of view. The quality elements for geographic data are divided into quantitative and non-quantitative subelements according to ISO standardization. The quality elements for cartographic data product are divided into visual and side element subelements non standardized manner. The quality model defines applicable data quality measures. The quality model defines general principles and inspection methods (attribute or variable) for quality evaluations. Quality information is reported as metadata and quality evaluation reports. Metadata provides quantitative and non-quantitative quality information and quality evaluation reports complements metadata with more detailed quality information. The standardization creates the basis for national and international co-operation among internal and external interest groups. At this point of the ongoing research project NATO Standardization Agreement (STANAG) aspects are under closer investigation and to be included.

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1. INTRODUCTION

This paper is based on the framework and concepts that were created for FDF as quality model. The basic structure and principles were presented first time in 4th International Symposium of Spatial Data Quality in Peking 2005 (Ingberg, Virrantaus 2005). The idea has been in coming years to continue to enhance the created quality model to be more appropriate to international co-operation. In practice and technical sense it means NATO interoperability. As GIQM and standardization is quite large area and practical implementation takes years to finish this paper is more like depiction of the current state of the art than end report of research work.

1.1 Background

FDF is probably the biggest Geographic Information (GI) end user in Finland and therefore the active role of FDF in GI standardization field is quite significant. As a background and motivation for the GI standardization activities FDF has declared in its strategy the trend for closer co-operation among Finnish industry and interest groups (Sipi 2004). This also includes GI. To ensure that FDF has in its use appropriate GI, well defined products is needed and standardization has a significant role in co-operation.

The usage of geographic information has increased during the past decades due the general evolvement in information technology and computers. The way the data sets are used has changed from the traditional digital cartographic production into different applications (Kresse 2004). The same kind of trend has also been noticed in military environment. The information of the actual quality level of a dataset and interoperability has become more important because the datasets are being used more and more in different decision making applications and analyses. According to NATO geospatial trends GI is used in weapon, command, control, communication, computer, intelligence, surveillance and reconnaissance systems (NATO 2006a). The quality level of consistent reference datasets has its own influence in hierarchical metamodel for military terrain analysis (Hyytiäinen 2003). The increased use of GIS technology and different datasets has also increased the importance of metadata for the end user (ISO 2003). The quality information is an important part of metadata.

Quality model which is the core of GIQM in this contest can be defined as a model or collection of methods and principles that assures well established quality level in data purchase process from the customer point of view.

First publicly available quality model in Finland was in year 1995 released quality model for Topographic Data Base by National Land Survey of Finland (NLS 1995). National Land Survey quality model is producer oriented and has been an inspiration for a customer oriented quality models. Although the view point of the research done has been customer oriented there is also a clear goal for quality management in GI from producer point of view. The goal for producers is to produce satisfactory product satisfying customer needs (Jakobsson 2004).

1.2 FDF quality model

The fore mentioned earlier work defined the quality model for GI in FDF (Ingberg 2004). The quality model defined was strongly based on international ISO geographic information standardization. Quality model defined data quality elements, data quality measures, data quality evaluation procedures and reporting of data quality. The principles in quality model were supposed to be applied in purchasing and quality assurance (QA) processes. Quality management (QM) in general was from the standardization point of view defined as coordinated activities to direct and control an organization with regard to quality including its general principles (ISO 2005). Quality in GI was from the standardization view point defined as ability for a dataset, a map product or a service to satisfy end users direct and indirect needs (ISO 2005). Data quality elements were studied separately form dataset and map product point of view. Data quality elements in dataset were divided into quantitative quality elements and non-quantitative quality elements according to existing standards. Data quality elements in map product were divided into visual quality elements and legend quality elements. Both quality elements were subdivided into data quality subelements. The utilization of data quality elements and subelements in map products was new approach to map product quality and approach had no standardization background as dataset had. Utilization of consistent data quality measures was found to be the only practical tool to compare quality level among different datasets. Quality model defined the structure of a data quality measure and provided practical data quality measures. The measures were based on ongoing standardization material of planed ISO 19138 standard. Quality evaluation procedure was defined as process which aim is to produce a clearly identified and measurable value to a dataset. To evaluate the quality level of a dataset there is also a need for consistent quality evaluation methods which were supposed to be used in consistent way. The quality model defined the general principles of quality testing. As a part of the testing process inspection by attributes and inspection by variables were used. Quality information of a dataset was presented in a consistent way as metadata and quality evaluation report. It was clearly noticed that standardization provides solid basis for successful national and international co-operation.

2. QUALITY MANAGEMENT

FDF is strongly committed to ISO 9000 series quality management standardization. Topographic Service which is the main GI provider inside FDF has ISO 9001 certificate that ensures in principle the quality of GI support (ISO 2000). On the other hand when thinking about data suppliers to FDF this means some more requirements in the invitations of tenders and contracts. As the ideas of ISO 9000 series based quality management has not been fully

recognized as a quality tool and general stable framework in GI community (excluding a couple of private companies) FDF has taken first steps to gently require quality management system from external interest groups also.

2.1 Quality management applied in FDF

The principles of quality management (QM) are applied in practice mainly as follows (ISO 2005). Customer focus is applied in purchasing process when FDF is buying GI from external interest groups. This leads to a situation that all the responsibilities of supplier exists as defined in QM requirements. On the other hand as a customer FDF has its own responsibilities. Probably the most important is that the customer has to know and be able to describe what it is buying. This means clearly defined products and requirements. According to QM principles supplier has to take into account also in some extent intended needs. In this situation the active role of supplier is appreciated. The activity towards FDF is needed to be able to keep up to date in various projects. Customer focus is applied internally other way around because Topographic Service is a supplier of GI inside FDF. Leadership is applied in a way that all the people in organization in a leading position have academic background complimented with military leadership training. Involvement of people is applied so that the key people in purchase process are trained with basic knowledge of GIQM. Also employees have a chance and instructions how to give feedback and bring up ideas through well pre structured development form. Process approach is applied in a way that all key processes are mapped and regularly reviewed with internal auditions. System approach to management is applied through the way military organizations are conducted which means in practice well organized action in every situation. Continual improvement is applied in a way that self assessment is part of organization work plans and the activities are assessed by external professionals yearly and improvement ideas are included in next year development plans. Factual approach to decision making is applied in a way that facts has to be documented and presented for example in the form of development form. Only after analyzing the case some decisions can be made. Mutually beneficial supplier relationships are applied in a way that the principles of GIQM and FDF organizational values are introduced to external and internal customers by seminars. This also includes active participation to annual GIS fair which is hosted by National Land Survey of Finland.

3. ISO GEOGRAPHIC INFORMATION STANDARDIZATION

FDF GI standardization is based on ISO 19000 standard series. ISO standardization is now a days the most important tool in co-operation among governmental organizations and probably also among private companies in Finland. Earlier created FDF quality model includes all the essential ISO 19000 primary and related standards: 19113, 19114, 19115, 19131, 19138, 2859, 3951. FDF adopts and implements fore mentioned standards in geographic information production processes. Governmental organizations are adopting ISO geographic information standardization through governmental recommendations which has been created by the initiative of Ministry of Agriculture in practical co-operation with Helsinki University of Technology. FDF has been participating in creation process as an observing member. Present recommendations concentrate first on metadata and quality. FDF

uses governmental recommendation (metadata and quality) as supporting material to complement the actual ISO standards. It is intention to use original ISO standards as much as possible. The usage of original ISO standards is helping FDF and Topographic Service as on organization to adapt to international co-operation.

4. NATO STANDARDIZATION AGGREMENTS

All the applicable GI related NATO Standardization Agreements (STANAGs) are maintained and included in NATO geographic policy (NATO 2003). STANAGs play a significant role mostly as GI product specifications. There is at the moment 57 primary STANAGs related to GI. The most important STANAGs are those that concern coordinate systems and feature exchange formats. FDF made a rough classification of those STANAGs from its own organizational standing point and it was noticed that 45 was army, 4 air force and 8 navy oriented. FDF adopts and implements all those step by step in the near future. FDF established a little expert group representing all the three armed forces which task is to find out the adaptation and implementation issues. In external co-operation the adaptation means more requirements in the invitations of tenders and contracts. The internal and external interest groups must be aware of the contents of related STANAGs, because those will be referenced. STANAGs are PfP/Unclassified by security classification. This is not an obstacle for the interest groups, it only means that FDF can provide those STANAGs to interest groups but certain security agreements have to be made.

5. INTEROPERABILITY

Recent changes in the security environment and the Finnish involvement in enhanced international crisis management will increase and expand the international cooperation of the FDF (FDF 2005). Participation in the development of international crisis management, as in NATO's Partnership for Peace (PfP) program is factor increasing and expanding international co-operation in FDF. Also permanent Nordic co-operation in peace-keeping strengthens Finland's opportunities to participate in international operations (FDF 2002). As part of European Union Battle Group (EUBG) through Nordic Battle Group (NBG) there is thought to be as an element a geographical support group included (Kerttunen et al. 2005). Topographic Service has a certain role planned in NBG.

PfP is a program of practical bilateral cooperation between individual partner countries and NATO (NATO 2006b). Finland has a Partnership for Peace (PfP) agreement with NATO. Finland participates in peace keeping activities through EU Battle Group (EUBG). Also the political discussion about NATO co-operation and future plans in its all forms has been quite active lately. FDF is technically committed to NATO Standardization Agreement (STANAG) adaptations and implementations. In international co-operation interoperable GI plays an important role to help the groups to communicate and to keep up to date situation awareness. Standardized products help to diminish the interpretation problems which might be in worst case even fatal.

FDF GI Strategy (Topo 2006) was internally released in early 2006 and it gives the guidelines for the development and organization of geospatial support on the long run. FDF GI Strategy is influenced in some parts of National GI Strategy (NLS 2004) and on the other hand by NATO Geospatial Policy (NATO 2006a). It is defined in FDF GI Strategy that international GI standards are adopted and implemented. The goal is to ensure interoperability through standardization. The most important standardization organizations are ISO, NATO and OGC. In international co-operation the GI activities are based on NATO STANAGs. International co-operation also means active participation in NATO/PfP and EU events and projects including multinational geospatial co-production programs known as MGCP. It is intention to work on basis of bilateral agreements between other countries in the field of GI support.

In national co-operation FDF is an active participant in already existing National GI Council governed by Ministry of Agriculture. FDF participates most actively in the field of metadata and harmonization. The idea is to get closer to data producers in production early stages so that FDF interests could be noticed. There is also a need for closer co-operation between different disciplines. GI disciplines are referred as geospatial and meteorological fields while military disciplines are army, navy and air force.

As it was mentioned earlier that STANAGs concerning to coordinate systems are in key role in GI interoperability. In Finland and in FDF there is ongoing a process to implement NATO compliant coordinate system.

6. CONCLUTIONS

At the moment there are quite many open issues or challenges concerning geographic information quality management and standardization in FDF. This also applies in external interest groups. The amount of standardization material is huge. To go through all the standardization material requires resources. As resources time and professional skills are the most important. The security issues also places some restrictions to convenient co-operation. It is can be noticed that some external interest groups have taken quality management systems into use.

During this ongoing research project the importance of data quality has become obvious in co-operation, performance and efficiency in FDF. Quality information is essential part of GI and its importance is growing. For the GIQM it is needed a broad range of different standards including; general quality management, geographic information and inspection methods. All the standards should be used and applied keeping in mind the customer focus. The standards used as a framework in this research project are a mixture of ISO, STANAG and national recommendations. The content of the standard has to be applied and complemented still in many situations. An important thing is to use the existing standards and professional knowledge and get as an outcome something simple and understandable enough to the end user.

The key thing in succeeding in bringing GIQM in to practical and productive use is the allocation of resources.

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