The Analysis, Design and Implementation for Quality Evaluation Methods of Surveying and Mapping Achievements

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Keywords: Surveying and Mapping Achievements, Quality Evaluation, Results Statistics, .Net Platform

SUMMARY

Surveying and mapping achievements' quality is important for the healthy development of industry. The fair evaluation can improve achievements' quality, and assist to build science quality evaluation system. With continuously enriching of surveying and mapping achievements and product, quality evaluation methods are becoming more diverse as well. Hence, this paper designs and implements quality evaluation software based on GB/T 18316-2008 "Specification for inspection and acceptance of quality of digital surveying and mapping achievements" and GB/T 24356-2009 "Specifications for quality inspection and acceptance of surveying and mapping products". It also takes account of the diversity and development tendency of quality evaluation, summarizes existing quality evaluation methods. It makes us count the inspection results and evaluate the quality of surveying and mapping achievements rapidly and conveniently. To some extent, it can also be as a reference for the formulation of scientific and fair quality evaluation methods.

SUMMARY

测绘地理信息成果质量至关重要，科学、高效的质量评价方法是评定测绘成果质量水平的关键。随着测绘地理信息成果与产品类型不断丰富，质量评价方法也更加多样化。因此，本文以GB/T 18316-2008 《数字测绘成果质量检查与验收》和GB/T 24356-2009 《测绘成果质量检查与验收》为基础，同时考虑质量评价的多样性及发展趋势对现有的质量评价方法进行了总结分析，设计并实现了质量评价系统，为快速对测绘成果进行检查结果统计及质量评价提供了便利，并在一定程度上为制定客观公正的质量评价方法提供参考。

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1. INTRODUCTION

With the rapidly development of surveying and mapping geographic information industry, the system of data acquisition, data processing and data service has been basically formed. As the same time, the application field and application range of the achievement and product are gradually enlarging. As the fundamental data of applications, the data quality of surveying and mapping achievements is particularly important. The quality evaluation of surveying and mapping achievements is an important part of the quality inspection of surveying and mapping technology system. Now, some check contents such as topological relations and field structures can partly be checked automatically and other contents are mainly be checked manually. However, the evaluation of digital surveying and mapping include all contents that checked automatically and manually (include accuracy check). Thus, how to combine the results of automatic checks and manual checks, and develop scientific and efficient automatic quality evaluation has become an important issue of quality specification research.

Combined the needs of surveying and mapping projects, this paper analyzed the present evaluation methods for surveying and mapping achievements, and then, designed and implemented evaluation software based on .Net platform. The software can give evaluation results of automatic checks, manual checks and precision checks. It provides technology methods for fair evaluation.

2. QUALITY EVALUATION OF SURVEYING AND MAPPING ACHIEVEMENTS

Now, the quality evaluation of surveying and mapping achievements is mainly based on GB/T 18316-2008 “Specification for inspection and acceptance of quality of digital surveying and mapping achievements” and GB/T 24356-2009 “Specifications for quality inspection and acceptance of surveying and mapping products”. According to the two standards, the quality evaluation of surveying and mapping achievements can be divided into five levels, which respectively are quality evaluation of lot, item, quality element, quality sub-element and test entry, as shown in the figure 1.Among them, test entry is the minimum unit of quality evaluation.

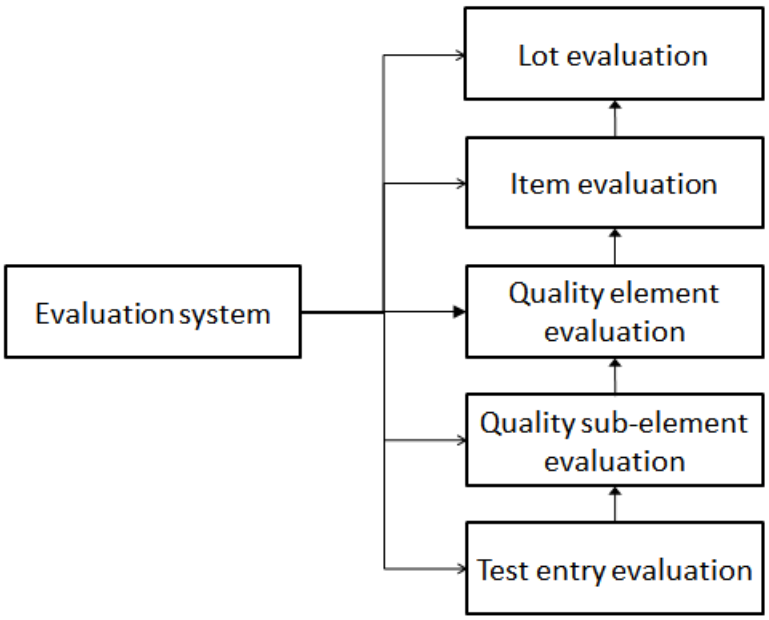

Figure 1 Levels of Quality Evaluation System

Each level of the quality evaluation has own corresponding evaluation method. The usual quality evaluation methods can conclude as follows: the sample average method, the weighted average method, the minimum value method, the penalty method, the error rate method, the root mean square method, conformity etc. Each level of the quality evaluation method for surveying and mapping results can be summarizes as shown in table1:

Table 1 Evaluation Levels and Methods

Quality Levels	Evaluation Methods
Lot	The sample average method
Item	The weighted average method The minimum value method
Quality Element	The weighted average method The minimum value method
Quality Sub-element	Deduction method The fault rate method The minimum value method
Test entry	The fault rate method The root mean square method The conformity method

These quality evaluation methods include usual quality evaluation method of surveying and mapping achievements. For example, the quality evaluation methods used by the first national geographic conditions survey project include conformity method, error rate method, the minimum value method, the weighted average method and the sample average method etc. The quality evaluation method of the 927 Project is based on GB/T 18316-2008 “Specification for inspection and acceptance of quality of digital surveying and mapping achievements” and mainly use the minimum value method.

2.1 Quality evaluation methods

(1) The sample average method: this method is mainly used to evaluate the quality of lot, and it use the average score of all items as the lot score.

(2) The weighted average method: this method can evaluate the quality of item and quality element. It needs to set up weight for the next level's weight, and use the weighted average score of the next level as the level's score. For example, you use the weighted average method to count item' score, you need to set up the weight of quality element for the result and use the weighted average score of quality element as the item' score.

(3) The minimum value method: GB/T 18316-2008 "Specification for inspection and acceptance of quality of digital surveying and mapping achievements" mainly use this method. It uses the minimum of the next levels' score as this level's quality score.

(4) Deduction method: this method set the level's score as 100 firstly, then deduct one by one according to the number and severity of the corresponding element's fault.

(5)The fault rate method: this method counts the fault number or area, calculates the ratio of the fault that accounts for the total number of elements or map area, then calculate the score according to the formula (1).

$$s = 60 + \frac{40}{r_0}(r_0 - r), r \le r_0 \qquad (1)$$

Among them, r_0 is the fault rate limit, r is fault rate.

The GB/T 18316-2008 "Specification for inspection and acceptance of quality of digital surveying and mapping achievements" divide the features into three levels, which is on the basis of the importance, that is: very important feature, important feature and general feature. When you count the fault number and area, you need to count the feature according to the important level. The feature fault rate limit r_0 of different level is different.

(6) The root mean square method: this method is mainly used to count mathematical precision of the achievements. The error value should participate in precision calculation which less than allowed error in 2 times (include 2 times); if the error exceeds 2 times, it is called gross error. In the same precision check, the mathematical precision counts all the error which allows the

root mean square in $2\sqrt{2}$ times (include $2\sqrt{2}$ times); if the error exceeds $2\sqrt{2}$ times, it is called gross error.

In high-precision check, the root mean square calculation formula likes formula (2); In the same precision, the root mean square calculation formula likes formula (3);when the number of the test point less than 20, we use the arithmetic value instead of the root mean square.

$$M = \pm\sqrt{\frac{\sum_{i=1}^{n}\Delta_i^2}{n}} \qquad (2)$$

$$M = \pm\sqrt{\frac{\sum_{i=1}^{n}\Delta_i^2}{2n}} \qquad (3)$$

In the formula, M is achievement mean error, n is the total number of test point, Δ_i is range.

(7)The conformity method: this method is generally used for evaluating the test entry. It judges whether the test entry meet the requirement or not.

3. THE DESIGN AND IMPLEMENTATION OF THE SYSTEM

The relationship is intimate between the surveying and mapping achievements quality evaluation and automatic check outcomes, manual check outcomes, precision check outcomes of the data, like figure 2.The system of this paper can realize the setting up of the quality testing evaluation parameter, automatic counting and evaluating of the quality testing outcomes.

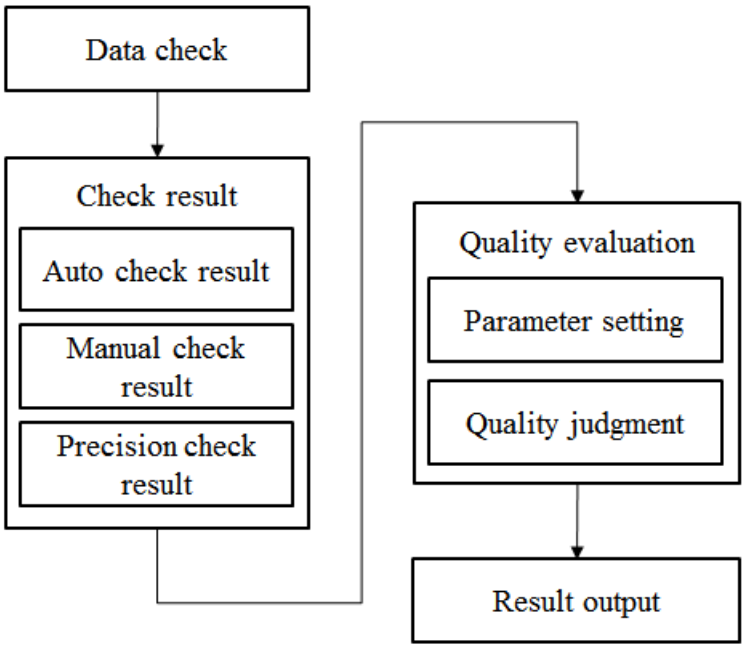

Figure 2 Quality Specifications

3.1 The main function design

The quality evaluation system mainly includes two modules: the setting up of quality evaluation parameter, the results statistics and quality evaluating of the check outcomes. The setting up of parameters includes the setting up of check limit, the choice of evaluation method etc.; the statistics of outcomes includes fault counting, score counting, the excellent and good rate counting etc. The setting up of the module of the main function likes the figure 3:

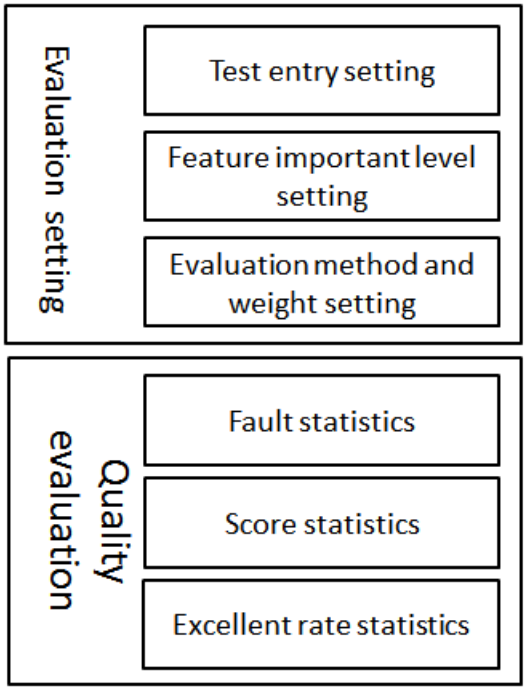

Figure 3 Function Modules

(1) The setting up of the evaluation parameters

The setting up of the quality evaluation parameters include the setting up of the test entry evaluation parameters, the setting up of element significance level, evaluation method of all levels and the setting up of the weight. The setting up of test entry evaluation parameters can set up the evaluation method of the test entry like counting fault number, area, the root mean error or conformity etc. The setting up of the element significance can not only set up the significance of the feature, but also set up the significance of field, like figure 4.

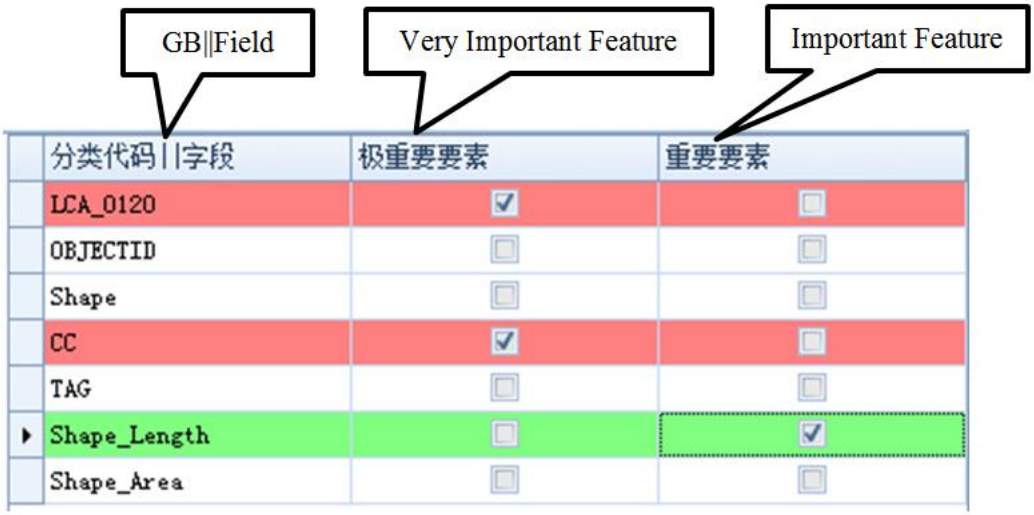

Figure 4 Importance Level Setting

The setting up of pameters can be saved as quality evaluation file. When you count check outcomes and score, you can directly upload the evaluation scheme file and count the outcomes and evaluate the quality on the basis of the evaluation scheme.

3.2 The implementation based on .NET platform

The quality evaluation system in this paper is implemented on the .NET platform. The delegate technology of the.NET platform and the XML file package, which read and write one by one node, make it convenient for us to use application program and provide plentiful support for the realization of the quality evaluation system.

The interface of the achievement quality evaluation module uses table type design, which keeps the same structure with GB/T 18316-2008, respect the use habits of users and ensure the usability of the software. The interface of the quality evaluation system likes the figure 5 shown:

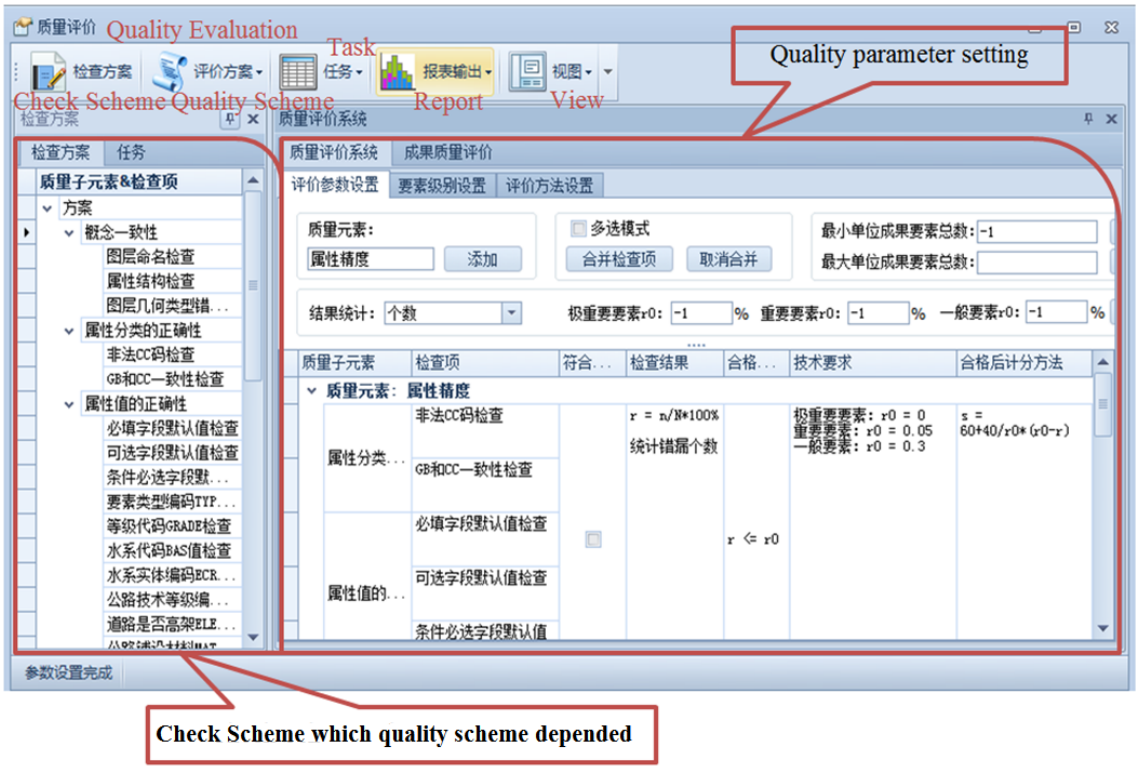

Figure 5 The Parameters Setting Interface

The interface of the result statistics likes figure 6:

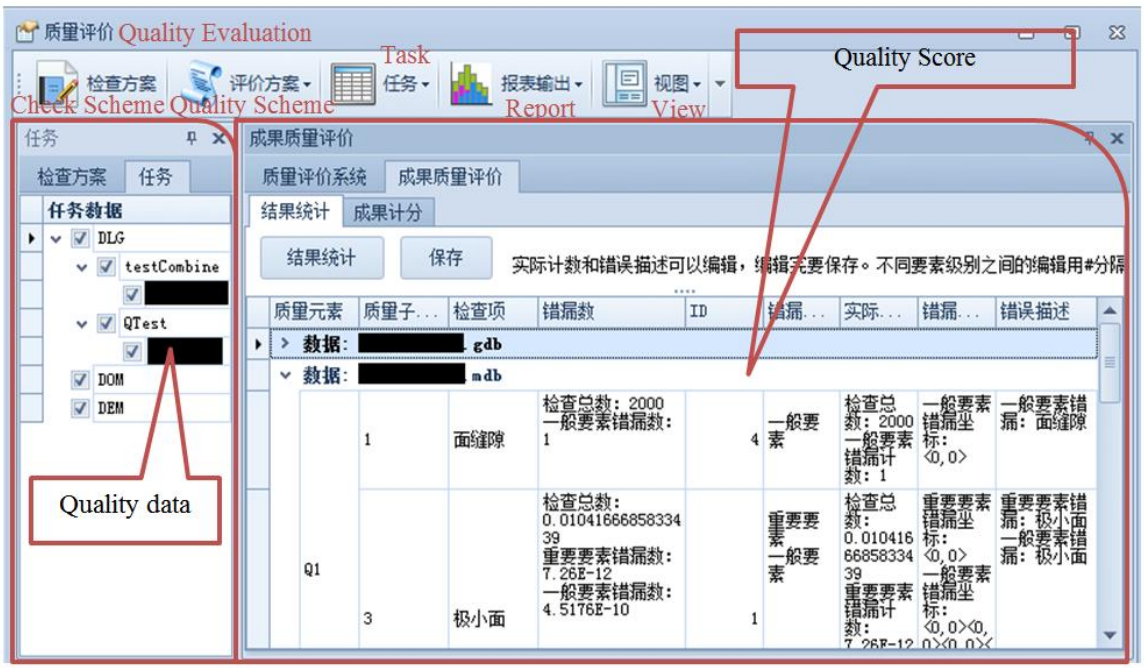

Figure 6 Result Statistics Interface

4. THE FEATURES OF THE SYSTEM

This system use hierarchical way to set up quality evaluation parameters. This design is of flexible and the extensibility of the software is better. It can be widely applied and easily preserved.

(1) The system provides parameters setting interface. Then, it can suit new project and enhance flexibility for achievement evaluation.

(2) The system enables test entry and quality sub-element to merge for scoring and then conformance to the standard.

(3) Fault statistics could calculate fault numbers in addition to calculate fault area. In the meanwhile, it enable to statistic widespread error to improve the system scalability.

(4) The system enables each level to select different evaluation methods. It guarantees the system practicality and availability.

(5) Parameters set in the system could save as a XML file. Then we could just set once in the same project and each task only open the XML file to evaluation its result. This is convenient for users to use, to ensure the fairness of the evaluation.

(6) Save statistical result to an intermediate file. The users can output different formats according to their needs.

5. CONCLUSIONS

The automatic evaluation software has applied to research of informationization of surveying and mapping geographic information system. The project commits to improving quality check ability, forms professionally check system and finally, provides quality check technology suited to production levels. The system has flexible design thought, independence of quality level and comparability between the same levels. These features are suitable for research of innovation system and through this platform, we could analyze achievements quality from different period and organization.

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