CAD EXCHANGE FORMAT IN THE FIELD OF PUBLIC WORKS JAPAN

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ABSTRACT: There is a CAD data exchange format named SXF (Scadec eXchange Format) in the field of Japanese public works. It was developed by a consortium in 1999 to be based on the ISO10303-202, so that the Ministry of Land, Infrastructure, Transportation and Tourism (MLIT) could start accepting e-delivery (e-submission) of CAD drawings. The development of SXF was one of the targets of the CALS/EC (Continuous Acquisition and Lifecycle Support/Electric Commerce) program which MLIT has been promoting since 1999.With most of local governments following the MLIT to accept e-delivery the SXF has become a standard format in public works in Japan. But many problems still remain. For example, many design companies or contractors usually use another CAD in their offices and convert their drawings into the SXF just before e-submission. This paper will introduce the standard of CAD exchange format SXF through the activities of Japanese public works.

Keywords: *CAD, CALS/EC, Public Works, Exchange Format, MLIT, SXF*

1. INTRODUCTION

The de-jure standard of 2D-CAD format in Japanese public works is called SXF, SCADEC eXchange Format. (SCADEC stands for Standard of CAD Data Exchange Consortium.). This format was developed by a joint consortium of public and private sectors in 1999, as an e-submission format to the public owners.

The SXF can be regarded as very rare example of such development in the world, as the unique condition in Japan then only made it possible. It was also referred as a good implementation model in STEP (ISO/TC184/SC4)

SXF is now mainly used as an output format but it is also used as an intermediary format between CAD applications.

2. GOVERNMENT POLICY AND CONSORTIUM

In 1995 the Ministry of Construction (now MLIT) of Japan established a meeting board 'Construction CALS/EC Researching Board', which was to authorize the CALS/EC Basic Plan and the Action Programs. The target of this basic plan was to establish an integrated system in which any information obtained at each stage (survey, designing, construction and maintenance) of public works should be digitalized so that every person of each section both in

public and private sectors could share and re-use the information (See Figure 1).
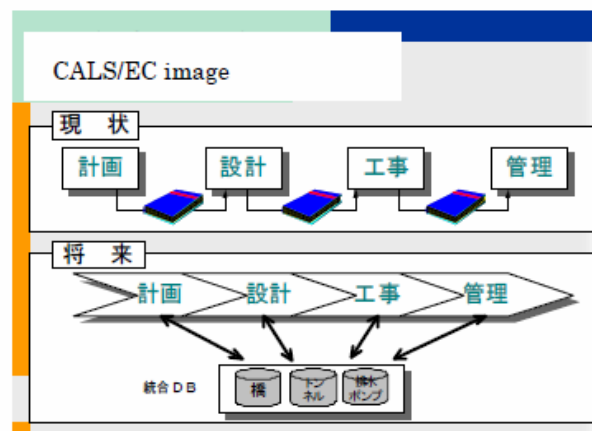

Fig. 1   Target of MLIT CALS/EC strategy

In 2000 the Japanese Cabinet established the basic strategy 'e-Japan plan', and integrated this MLIT basic plan as a part. Then, a large budget was allocated to the IT policy and the SXF was developed thanks to such a big flow.

The e-procurement and e-submission were the main 2 targets of the CALS/EC Basic Plan of MLIT. The SXF was developed in such a context, because a standard CAD format was indispensable to begin e-submit of drawings. Because there were many (over 30) CAD venders then in

Japan, we could not start e-submission of drawings without a standard format. Autodesk, Inc. had a dominant market share in the building architecture field then, but in civil engineering field there were many venders (See Figure 2).
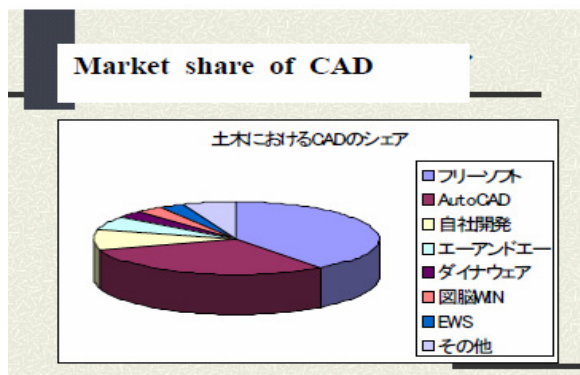

Fig. 2   Market share of CAD in Japanese civil engineering

The figure shows the market shares of CAD in Japanese civil engineering field in those days. Number 1 was a free soft named JW-CAD, at 40%, and the 2nd was of AutoCAD, at 35%, and other many CAD software programs together occupied 25%.

Generally speaking the definitions of the features among those venders are all different and so one couldn't get an accurate shape in a CAD if written by another application. The format of CAD differs by application, too.

If we had done nothing in the construction field then, AutoCAD might have conquered the market share indeed.

But many people in the MLIT board thought that it would be good also for the Japanese machine industry if one standard specification would be determined. And it is decided that the authorized standard for the new specification should be within the framework of ISO standards.
Government officers, in any country, would take it ideal that the government could use a unified open standard. But the situation seldom allows them to do so. But there was much energy vital in Japan in those days and many private companies participated in the project at their own risks.

Standardization activity was initially led by a Consortium named the Standard Development Consortium for CAD Data Exchange (SCADEC), which consists of more than 200 CAD software venders, design companies, contractors, central/local government bodies and academic experts, with JACIC (Japan Construction Information Center) as its secretariat.

Representatives of Japanese venders estimated that they needed about $2 million to develop the new specifications for CAD. The MLIT couldn't afford it in that year's budget, so the consortium sought another money source, the research fund of Ministry of Economy, Trade and Industry. Such a move is almost impossible under the current low economic growth, but in those days Japanese public and private sectors joined together to develop a de-jure standard marvelously. And within an amazingly short period of 18 months, the Consortium completed this marvelous task.

3. THE REFERENCE OF ISO10303-202

To avoid the infringement to the Treatment for Technical Barriers to Trade (TBT), MLIT planned the exchange

Table. 1   STEP standards and AP

部	組の名称	JIS規格
1	概要及び基本原理	JIS B 3700-1
11～19	記述法	JIS B 3700-11
41～99	統合リソース: 総称リソース	JIS B 3700-41,42,43,44,45, 46,47,49
101～199	統合リソース: アプリケーションリソース	JIS B 3700-101,105
31～39	適合性試験の方法及び枠組み	JIS B 3700-31、32、34、
201～1199	アプリケーションプロトコル	JIS B 3700-201,202,203、214、225
1201～2199	抽象試験スイート	
21～29	実装法	JIS B 3700-21

standards to be based on some ISO standards. Because in those days the amount of construction investment in Japan was over $800 billion, there was much argument on TBT as well as some pressure from the US.

We decided the base standard of SXF to be one of STEP (=ISO/TC184/SC4). Prof. Terai recommended AP202, which was developed mainly for cars, for that.

We made the specification of SXF as a subset of ISO10303-202. We spent almost 2 years in STEP conferences until the STEP members agreed that our SXF specification should be a subset of 10303-202. We attended the STEP conference many times to adjust our

specification and at last they approved and opened it on the plenary of Fukuoka conferences in 2000 as a good model for the implementation of a STEP standard.

4. CAD DATA EXCHANGE WITH SXF

After the adjustment of SXF at STEP, MLIT adopted SXF as a formal format of e-submission, and indicated that in its E-submit Guideline of CAD.

The version 1 of SXF was just a prototype at that time. So it was refined into the version 2, which was actually used in e-submit. MLIT requested the design companies to use the SXF format for their output from 2001. Further refining work had to be done by the start of e-submission. Construction Information Standard Committee (CISC) was
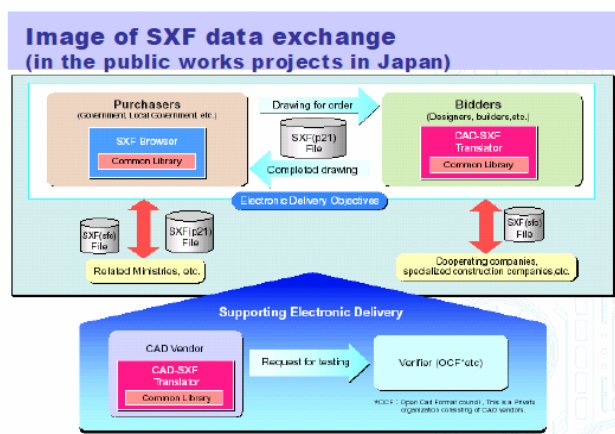

Fig.3 The system of e-submit

established in 2000 by JACIC and the activity of SCADEC was succeeded by a sub-committee of CISC. The SXF ver. 2.0 was developed by this committee in 2001 and this format was first applied to the design works and then to the large scale construction works, and to all of the directly-controlled works in MLIT successively.

I now think these activities were accomplished very fast despite many factors concerned, and that it would be impossible to do the same task in present Japan.

The system of e-submission in the CAD exchange format is shown in figure 3.In order to promote developing CAD software for reading and writing SXF data, several measures have been taken, as described below.

(1) MLIT developed a common module function library for implementation and SXF browsers through the working group of CISC, aiming that the public users could read the SXF drawings freely and that the venders could develop new CAD software.

(2) The CISC working group and JACIC carried out many function tests with real CAD data in order to verify whether drawings were completely identical before and after data exchanges via SXF input/output functions.

(3)CAD venders developed new CAD software to modify their own products with additional functions of SXF, so that the designers and contractors would use SXF format for e-submit.

Many CAD applications were issued in 2001 under this policy. But at that point, the quality of new software was a serious problem. A neutral organization had to authorize these products. It should not be JACIC under the policy of MLIT. The Open CAD Format Council (OCF), a non-profit organization of CAD industry, was assigned to test and authorize CAD software, SXF browsers, and SXF checkers, whether they conform to the SXF specifications.

Fig.4 The logotype of OCF check

In other words, CAD venders will check their own products within their industry. This system continues today.

5. PRESENT STATUS OF SXF

With such history, the CAD format SXF was adopted as a formal format of MLIT for the e-submission started in 2001.

Many local governments followed MLIT and made their own Guidelines of e-submit. Now, the SXF format is applied to public works of about $20 billion.

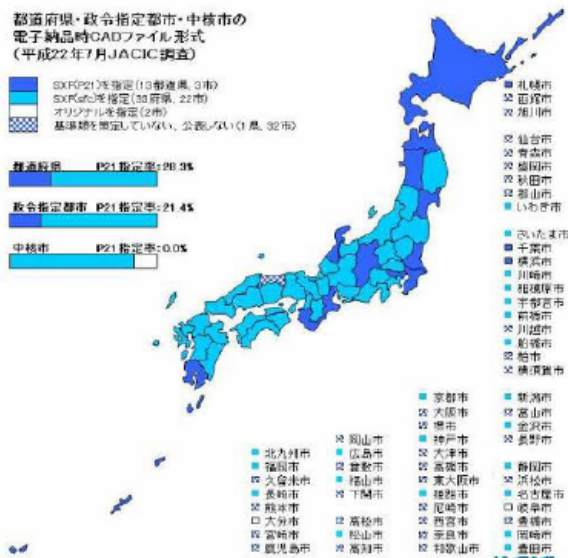Figure 5 shows the status of SXF in Japan.

Fig.5　Adoption of SXF by local governments

Japan has 47 prefectural local governments and 19 special large city governments. Most of them adopt this format and assign in their e-submit Guidelines.

As for venders, SXF is now an open standard whose newest version 3.1 is opened on the web site of MLIT.

And the SXF common module function library has been downloaded for 362 software programs of 192 venders still June 2008. OCF has authorized 22 CAD software programs of 16 venders and 7 browsers of 4 venders till May 2010. Bentley's Micro Station and AutoCAD were of course one of them.

When the SXF was revised and equipped with the function of clothoid curve in 2008, it was declared that the specification project of SXF in 2D was finally completed. It meant that CAD venders would make their software at ease because no further changes in 2D specifications would occur. After this declaration, Japanese construction technical research in general inclined toward 3D.

MLIT had another program for local governments. It was made in June 2001 and called "Expansion of the CALS/EC to Local Government". Under this program, the e-procurement by an e-bidding system and the e-submission by SXF were to be expanded to all local governments by the end of 2010 (Fig 6).
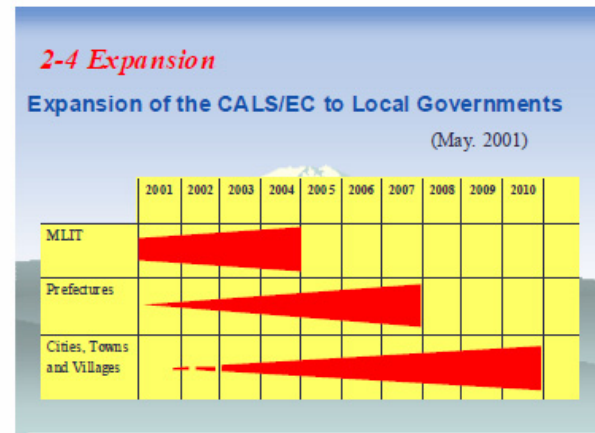

Fig.6　Expansion plan to Local Governments

Now, in 2011, this expansion strategy of MLIT seems to have been successful in a sense.

6. TODAY'S PLOBLEMS

The standardizing task has been completed at last but some practical problems remain.

Although the SXF has prevailed among local governments as above, the format of SXF has not yet to be the de-fact standard in the public projects in Japan. It is not thoroughly used in the field. There are some factors to keep this format from spreading, as below.

Firstly, this CAD format is not very much used in offices of designers or contractors. They use the SXF only for e-submission to the governments. In terms of the market share, the AutoCAD is still No.1, dominating other software. Many Japanese designers and contractors usually use AutoCAD for their daily work and convert the format into the SFX just before e-submit. Because the SXF is designed as an exchange format so its function level is not really high. Many engineers would like to use high-functioned CAD applications and they often ask to site officers to allow their drawings to be submitted in an original format, because it is easier for them to avoid the conversion.

The site officers in public sectors are inclined to accept the request when the officers don't understand the importance of the SXF format.

Why is the conversion from the original format to the SXF annoying for the contractors?

One reason lies in its checking system requested before the e-submit to all the out-put documents. The checking system is very detailed and severe. If there is a careless
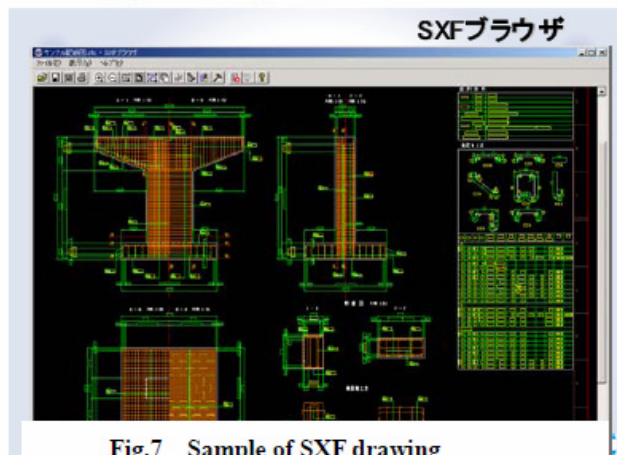

Fig.7　Sample of SXF drawing

mistake in a document, the checking system rejects the document for e-submission. That is also a reason why the contractors don't like to use the SXF format.

Secondly, the significance of the WTO treatment is not well understood now. The importance to keep this rule is very vague　now in Japan, because the background conditions have changed since then.

There are 2 types of the SXF format, sfc and p21 from the beginning. The former is lighter but not based on the ISO standard, and the latter is heavier but based on the ISO standard.

MLIT developed a lighter type sfc because p21 type is very heavy for machines, which means it need much time to run in the machines. So people would like to use sfc more than p21. But the sfc type does not meet the WTO treatment indeed, which is a problem.

Yet some local government officers rather support sfc, saying that they never encounter such large projects as subject to the WTO rules hence no need for P21.

We have to discuss this matter again with 10 years' experience.

Thirdly, there is a technical problem also on the side of local government officers. CAD is a new technology for the government officers. Most of them are not familiar with the CAD software, yet they have to receive huge amount of the CAD drawings every day. They cannot check the quality of the drawings because of their lack of knowledge on CAD technology. That is the problem of a technology

gap. MLIT has hundreds of offices in districts, controlling the construction projects and keeping the maintenance of public facilities like highways, bridges and ports. There are tens of thousands of engineers in those offices. The technical education for them is now a big task.

The SXF format is now widely used in public projects in Japan but it contains many problems actually.

7. FUTURE CHALLENGES FOR SFX DRAWINGS

We have future challenges, too, for SXF drawings as below.

(1) Re-use of the drawings

10 years have already passed since the e-submission was started in Japan. And there are much data accumulated in the government offices. But this CAD data is not used for the maintenance stage yet. It means that e-submission data is not re-used at all for the maintenance of public facilities, which decreases the value of e-submission.

On the other hand, at the maintenance stage of public works, paper drawings are mainly used even now. Therefore the master drawings of the facility are not revised concurrently at present. If there is a system to utilize the CAD drawings at the maintenance stage, what we have to do is　only to joint the systems together. This problem contains some institutional themes, too.
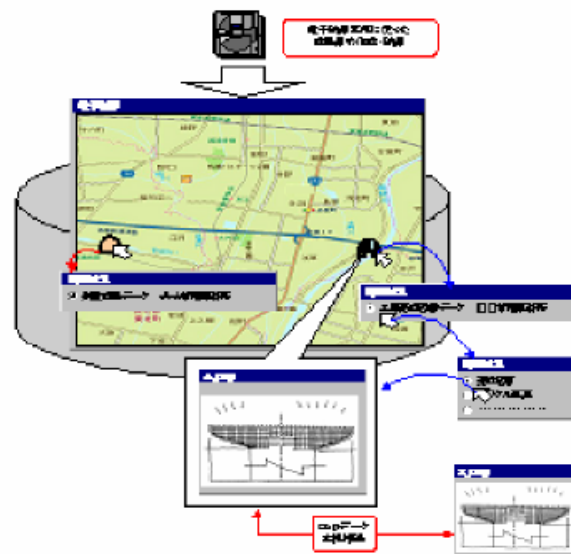
(2) Combine with GIS data

Fig.8　Joint image of CAD and GIS

The value of CAD data seems to be much increased if they are combined with GIS data. This theme was announced as early as 10 years ago. Actually electric power companies and the gas suppliers have already equipped their systems with GIS facilities. But Japanese government has not started doing so yet.

We, construction information engineers interfacing between the construction field and the information technology, have to make efforts on those themes for the future, too.

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