Measuring Software Assets in a Public Organization – A Case History from Provincia Autonoma di Trento

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Abstract

This paper presents the setup and the implementation of a program for the definition and the measurement of the software assets of 'Provincia Autonoma di Trento' (Trento's Autonomous Province), including to date more than one hundred software systems and applications on several technological platforms. Particularly, the paper describes: the reasons that led to the realization of such program, the data collection structure and procedures, the difficulties encountered in the collection process and the corresponding practical strategies, the current resulting data set (contents and quality), the resulting considerations as a trace for the schematic generalization of a "software assets" program and process.

1. Introduction

Trento's Autonomous Province ("PAT" hereafter) is a government agency which, together with Bolzano's Autonomous Province, forms the Trentino – Alto Adige Region. The Italian legal system grants a special autonomy to both the Region and to the two Provinces (a unique case in Italy) from 1948. A special charter, which was reviewed in 1972 and updated in 2001, mainly assigns the two Provinces the right to issue their own laws in a broad number of areas and to execute the relative administrative functions (Tab. 1)[1]. In other words the Autonomous Province is a partial replica on a local scale of the nation's complex administrative structure. PAT is composed of 67 different services, distributed over 15 departments (October 2003) [1].

Table 1 Autonomy granted by charter to the Trento and Bolzano Provinces.

Autonomy in political policy	The right to decide its own line of action according to a political policy not necessarily the same as the policy adopted by the Italian Parliament.
Legislative (authority) autonomy	**Exclusive**: the Province issues laws only in accordance with the Republic's general legal principles and major economic and social reforms, in a broad range of subjects that concern the territory, the economy and services[2].
	Competitor: the Province can make laws in compliance with specific principles established by Government laws (trade, industry, sporting activities, Healthcare and other areas).
	Delegated: when the Government grants the Province a specific mandate to intervene in the sectors under its jurisdiction.
	Supplementary: the Province limits itself to adapting Government regulations to local needs.
Administrative autonomy	The Province executes the administrative functions in the same areas in which it has legislative jurisdiction. Furthermore, the Province can execute administrative functions on behalf of the Government or the Region (administrative mandate).
Financial autonomy	The Province is funded mainly in the form of the Government grants which it returns mainly in fixed instalments from the income collected locally almost entirely generated by Government taxes (on the income of natural persons and bodies corporate, on value added, registration, manufacture, tobacco consumption and other items). Moreover, the Province can establish its own taxes (for example: on tourism) and participates in "sector provisions" (Regional funding established by Government laws).

[1] The Trentino - Alto Adige Region has been granted autonomous jurisdiction with an essentially "regulatory" nature since 1972, which entails making provision to define the institutional reference framework in relation to given sectors. The Municipality is the other local territorial authority, which provides services to its citizens; there are 223 Municipalities within Trento's Province.

[2] Safeguarding the historical-artistic heritage; safeguarding the countryside urban and town planning; hunting and fishing; agriculture; handcrafts; building industry, road networks, aqueducts, public works of interest to the Province and expropriation for public use; kindergartens, primary and secondary education, school buildings, professional training and other services.

Obviously, PAT needs to be provided with several specific software applications to manage a broad variety of data, given the local regulations and procedures to manage public deals, at a central level, at single offices' level throughout the territory and at the institutional counterparts level (such as schools, public bodies and local authorities), not to forget the principle direct counterpart (the citizen). The supply of those applications is governed by specific contractual agreements and to-date this is executed almost exclusively by a single software house, controlled partially by public participating interest (PAT itself): Informatica Trentina ("IT-supplier") [2].

The number of software applications managed exceeded 100 systems, as declared by the IT-supplier at the beginning of 2003, 58% of which are of the "4GL" type, corresponding to a (declared) total of 64,000 IFPUG unadjusted Function Points, and 42% of which are of the "3GL" type, representing a (declared) total of 48,000 "equivalent" Function Points (obtained from the Source Lines of Code using a contractually defined conversion factor).

At the beginning of 2001, PAT combined the Information & Organisation Service ("SOI") in a single structure; this structure, among other aspects, is responsible for the following activities:

- to promote and coordinate implementation of the provincial IT system and to define the IT needs, also on the basis of specific requests made by others provincial structures;
- to manage relations with the companies that provide the IT services, as well as checking and monitoring the aspects relating to the supply of the services (Fig. 1).

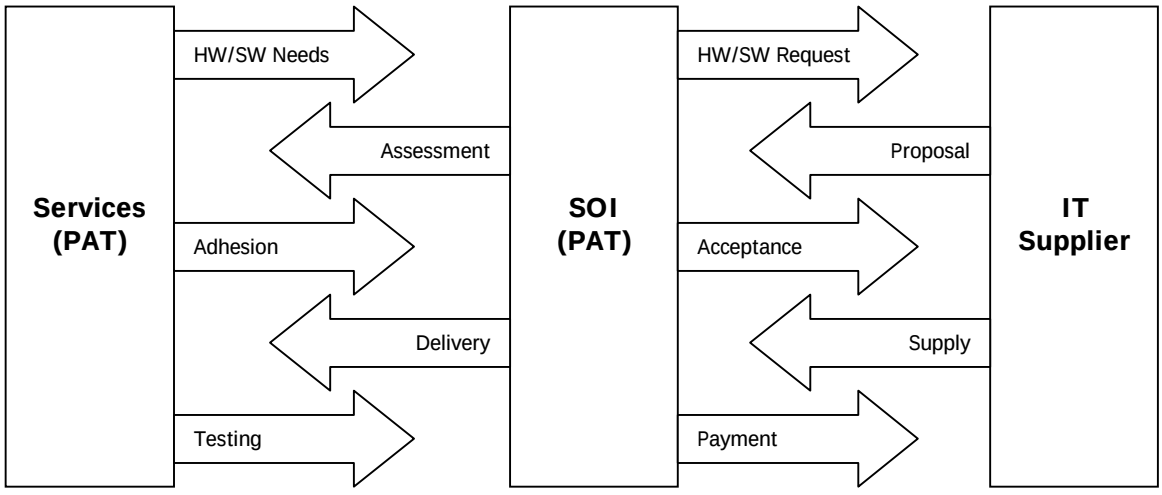

Fig. 1 Brokerage/negotiation role played by the Information & Organisation Service (SOI).

Finally, at the end of 2002, SOI hired the Data Processing Organisation ("DPO") as a consulting company in relation to the Function Point assessment of the software applications. DPO was hired after a public call for tender, considering the possibilities offered in terms of expertise in the metrics field (personnel at CFPS level – Certified Function Point Specialist), training, assistance and know-how transfer to SOI's internal managers, and technical tools and supportive measurement methodologies, such as the Early & Quick Function Point estimation technique [3] and the 'Sfera' suite as a support to software measurement [4].

2. Objectives

The start of a software assets assessment and measurement activity has its origins in the initial joint activity engaged in by SOI/DPO, co-operating with the IT-supplier, to audit and review the division of the entire provincial IT system into a number of applications with their own boundaries. The software assets currently consist of approximately 120 systems of various type and domain, according to the division proposed by the IT-supplier, implemented on different technological platforms. The initial intention of verifying the software boundaries evolved into the objective of defining various major aspects of the application assets in a harmonised and structured form to facilitate change management and the relative cost & time predictions for new development, enhancement and maintenance tasks. Execution of the main objective involved – and is currently involving – a number of secondary assessment items, which are equally interesting in terms of IT system management, as will be seen in the sections below.

The general objective of the "software assets" project is to establish a reasoned census – or inventory – of the applications and their functionalities, maintained up-to-date and including attributes that provide support in managing current and future development, enhancement and maintenance activities relative to the applications in question. The potential objectives of the software assets are many-sided; for example, they include providing support to the following activities and services:

- correct sizing and containment of the system management costs;
- internal and external benchmarking activities;
- monitoring the performance of the supplier and of the systems' administrators;
- decisions regarding new projects.

The flow of processed information is reflected in the phases illustrated in Fig. 2 in terms of the overall knowledge of the software assets and the supply projects.

Phase	**Census**	à	**Assets**	à	**Projects Catalogue**	à	**Benchmarking**
Subject	Applications		Applications		Projects		Projects
Detailed analysis	Systems' inventory Lists of modules or sub-systems Functions lists (data and processes)	à	Systems and functions classification Systems and functions measurement	à	Projects inventory (development and maintenance) Estimate (size/timing/costs)	à	Projects inventory (development and maintenance) Measurement (size/timing/costs)

Fig. 2 Flow of processed information relating to software assets.

3. Data Set Structure

The 6 well-known rules of journalism ("who", "what", "where", "when", "why", "how" – 5 Ws' + H) have been considered as a guide to identify the attributes of the software assets, while adding a seventh fundamental aspect in the distinctive metric scenario of the subject being analysed, "how much". The table below (Tab. 3) shows an essential list of the attributes and an identification of the corresponding information actually collected in the initial phase (the characteristics of the "why" or motivational aspect have not been considered as relevant to the field of investigation). It's worth noting, for certain data, that it has been found essential to distinguish between different sources.

Table 2 Structure of the predicted and collected information in the first phase of the PAT software assets scheme (data specifically associated with benchmarking or productivity aspects are not shown).

Aspect	*Characteristic / Predicted parameter*	*Characteristic / Collected parameter*	*Source*
Who/1 (Supplier)	Supplier	(IT-supplier)	-
	Area/ Department/CC (Cost Centre)	Area	IT-supplier
		CC	IT-supplier
	Sub-area/Sector/Office/Group (supplier)	-	-
	Manager (supplier)	IT Manager - supplier	**IT-supplier**
		IT Manager - supplier	**PAT ref. persons**
	Technical Reference Person (supplier)	IT reference person for change request	PAT ref. persons
		IT reference person for support request	PAT ref. persons
Who/2 (User)	Organization	(PAT)	-
	Area/Department/Service (user)	Macro - user	**IT-supplier**
		PAT SERVICE	**PAT ref. persons**
	Office/Group (user)	Office/Offices using the application	PAT ref. persons
		Non-PAT users (schools, private citizens,…)	PAT ref. persons
	User base	Number of users (1, 2-10, >10, >>10)	PAT ref. persons
	Manager (user)	(Compiler)	PAT ref. persons
	Technical Reference person (user)	PAT reference person for the application	PAT ref. persons
What	Project/Macro-system	-	-
	Application/System	Identifier	IT-supplier
		Application Description (Short/Extended) (IT)	**IT-supplier**
		Application Description (Short/Extended) (PAT)	**PAT ref. persons**
	Module/Sub-system/"Groups" of functions	-	-
	Functions (Data/Transactions)	-	-
	Owned (Y/N or "owner")	PAT property (Y/N)	IT-supplier
	Included in Assets	Included in Assets (Y/N)	SOI
	Actually utilised	Actually utilised? (Y/N)	PAT ref. persons
		Not used, but necessary for historical data? (Y/N)	PAT ref. persons
How	Documentation – Type	Documentation type	SOI
	Documentation – References	Documentation link	SOI
		(Documentation request) (Y/N)	SOI
	Platform(s)	Execution framework	IT-supplier
		DBMS	IT-supplier
		Operating System	IT-supplier
		T.P. monitor	IT-supplier
	Language generation (primary)	Type (3GL/4GL) ("*Platform*")	IT-supplier
	Programming language(s)	Development environment	IT-supplier
	Architecture	-	-
	New development or customised package	-	-
	Percentage customised (if a package)	-	-
Where	Location	Refer to "Who/2 (User)"	-
When	Operating status	In operation? (Y(/N)	SOI
	Project starting date (start of development)	-	-
	Starting date (release/in operation)	Operational from (ddmmyy)	**IT-supplier**
		Start date	**PAT ref. parties**
	Closing date (disposal)	Release date	**IT-supplier**
		Release date	**PAT ref. persons**
	Milestones of the development project's life cycle	-	-
	Usage frequency	Usage frequency (d, w, m, quarter, six-months, y)	PAT ref. persons
How much	Measurement unit (FP, LOC, etc.)	FP ("4GL") / FP equivalents ("3GL")	IT-supplier
	Size (FP, LOC, etc.)	UFP	**IT-supplier**
		UFP	**SOI/DPO**
	Adjustment factor	(VAF defined contractually)	-
	Adjusted size	UFP × VAF	IT-supplier
		UFP × VAF	SOI/DPO
	Measurement standard	(IFPUG 4.0 up to September, 2003) (IFPUG 4.1 starting from October, 2003)	-
	Measurement manager	Measurement manager	SOI/DPO
	Measurement date	Measurement date	SOI/DPO
	Measurement reliability	Consistent (Compliance with standards) (Y/N)	SOI/DPO
		Quantitatively correct (Y/N)	SOI/DPO
	Development cost	-	-
	Management cost	Annual maintenance cost	IT-supplier
	Function Breakdown (Functions distribution)	-	-
	Average FPs' per Function Type	-	-

3.1. Data collection (and management)

The data relative to the software assets is collected using three principle methods:

1. Analysis of the provincial electronic system inventory, updated quarterly by IT-supplier.
2. Collection of support information by SOI, based on direct interviews of PAT reference persons for software applications.
3. Internal audits by SOI/DPO, regarding the descriptive and quantitative information proposed by the IT-supplier.

As regards the first method, the IT-supplier transmits a list of operating software applications every three months with details of the Function Point size (IFPUG 4.0 – starting from October 2003: IFPUG 4.1) and an estimate of the Function Points for the next six-month period as a result of enhancement projects or new applications being developed. This document provides the annual management costs of the applications in operation in the so-called Provincial Electronic Information System (SIEP). These costs are sustained for each operating application on an on-going basis for the entire duration of its operating period, based on a rate per FP that is different from the development or maintenance rate.

The inventory supplied by the IT-supplier provides descriptive and quantitative information based on the division of the systems and their boundaries which are currently the subject of a review by SOI, as well as the declared size values for a significant part of the systems. Furthermore, this size value is not kept up-to-date in this inventory, in the case of a limited number of systems, starting from certain dates, since these systems are managed "on a lease rental basis", namely based on a lump-sum solution.

This collection method represents the supplier's point of view (IT-supplier) in relation to the software assets.

As regards the information collected by the PAT reference persons assigned to the applications, this activity was carried out on the basis of phone interviews with the applications' main users; this solution was adopted to obtain precise and real information, since the documentation produced by the supplier was found to be sometimes incomplete or did not allow an unambiguous interpretation to be made.

First of all it was necessary to carry out a preliminary analysis of the list of applications, deduced from a copy of the quarterly inventory, based on a description of their functionalities and objectives to succeed in linking them with a clearly identified PAT service or structure. A second step was to interview the executives of the PAT IT sector involved in the provincial services providing support to IT-related requests to succeed in obtaining the name of the reference person as regards the operational use of the software. These executives are normally involved in the beginning of a development or maintenance project and in the subsequent design phases up to the date of release; consequently, it was possible to obtain useful information already in this phase as regards approximately 50% of the applications. The IT reference persons (PAT) working in the provincial services sector were involved as regards the remaining part of the software assets. This type of resource was established as a collecting point between IT-related needs of the service itself and SOI or the IT-supplier. The IT reference persons were able to identify the final users so as to be able to set up interviews to obtain the remaining information.

This collection method represents the final user's (PAT) point of view in relation to the software assets.

Qualitative and quantitative reviews of a part of the systems were carried out by SOI with DPO support, making an independent assessment, regardless of the value declared by the IT-

supplier in the quarterly inventory. Measurement – or estimations – were based on the available documentation provided with the systems. The primary subject of the audits are the choice about the boundaries proposed by the IT-supplier, the functional size of the systems expressed in IFPUG Function Points, the impact of the enhancement projects on the pre-existing systems, the overlapping, if applicable, and potential functional or technical reuse among neighbouring or collateral systems. The primary data source is represented by the documentation provided by the supplier with the systems examined, with occasional inspections on the operating software to verify, on a random basis, the compliance of the documentation or to resolve particular ambiguities in the interpretation of the documentation.

In case of a significant deviation between the size measured or estimated internally and the value declared by the IT-supplier, for example, action is taken to jointly compare the detailed functional items of the system under review, such as the lists of data type and transaction type functions and their functional complexity.

This collection method represents the technical principal's (SOI) point of view in relation to the software assets.

3.2. Support (and management) tools

Standard office automation tools, such as a spreadsheet, were used in the very early phases of collecting the assets-related data. The creation of an IT repository has been foreseen on Access / Lotus Notes platform, to standardise and ensure greater rationalisation of the information collected. A similar tool will enable information useful in managing and maintaining the assets in question to be extracted using suitable queries and reports.

The data collected will need to be processed to ensure:

- ready access to the information with searches applied to numerous fields, designed to identify applications, sub-systems or single functions that are similar to one another or analogous to those that need to be implemented for new projects or initiatives, for example, to assess the possibility of software reuse;
- data browsing from several points of view, to seek out the functions that are part of a given application or from which application specific functions are utilised, for example, to enable re-engineering activities that optimise the code used;
- identification of the relationships between data, functionalities and objects of the selected measurement method (IFPUG FP of future metrics), to enable a given change to data or functionalities to be assessed immediately in terms of the impact on size;
- queries and reports in support to the decisions made by managers.

Finally, it is expected that the structure and the nature of the information forming the software assets in the future may find adequate confirmation in the use of logic (graphical-visual) tools to model the systems and their functional components, in a way similar to the techniques already in use to model the software components – an example of this presentation method is provided in [5].

4. Difficulties encountered when collecting and managing data

The difficulties encountered in data collection and analysis are mentioned below, referring to the three methods previously depicted.

4.1. Quarterly inventory analysis

Although apparently unimportant, a very difficult aspect when managing inventory data, due to the large number of systems involved, is represented by the supply of the above in the IT-supplier hardcopy format (as well as the majority of the communications and a copy of the documentation requested to be provided with the systems and their relative analysis).

A second difficulty consists in the complexity of the audits on the inventory changes, from one quarter to the next. It was found virtually impossible to reconstruct the systems' development history in not recent years (before 2001), given also the relatively recent formation of SOI and the even more recent date of setting up the assets project.

The ability to manage the inventory is considered crucial in order to optimise and rationalise the costs of the applications that are actually used in the PAT structures (cfr. the "collateral" positive result – in next section - regarding the disposal of obsolete systems). A process to streamline the procedure of periodically receiving and analysing the inventory is being studied by SOI/DPO.

4.2. Interviews with PAT reference persons

The greatest difficulties encountered during the interviews mainly depended on finding the correct reference person, since often the employees that were following the procedure had changed their job (turnover) or were simply unavailable. This entailed a significant reiteration of the calls.

In the second place, an additional effort was frequently required to overcome the user's "suspicion" towards the interviews in general: a number of interviewees stated that they "had no time", while others were just waiting for the opportunity to talk about the frustration they experienced because of the problems with the supplier.

A correct sponsorship of the interview activities and a clear statement of the specific purpose and the potential positive effects for PAT's entire organisation are useful tools to reduce the difficulties experienced in this method of collecting information.

4.3. Internal audits

The difficulties intrinsic to the third method of collecting data were essentially the following:

- difficulties in retrieving the documentation up-dated to the actual projects' status: in addition to being supplied very late compared with the date the official request was made, the documentation was frequently found to be incomplete as regards a number of portions of the system, thereby not enabling a detailed audit to be carried out on the characteristics and sizes declared by the IT-supplier;
- in a number of cases SOI was unable to access the systems in operation (for technical or security management reasons);
- an initial dissimilarity in the interpretation and approach to applying the estimate and measurement methods between SOI and DPO.

This latter critical aspect was overcome by implementing an adequate approach of side-by-side work and know-how sharing between DPO and SOI, adopting various methods such as

ad hoc training and distribution of specific guidelines regarding measurement methodologies in particular scenarios.

5. Progress and initial results

The internal audits phase proved to be especially demanding and therefore can be considered as completed to a percentage of less than 20% (relative to both the total size of the systems and in terms of their number), while the formal analysis of the quarterly inventory can be considered as executed periodically to 100%, and the interviews phase detailed above highlighted a limited number of residual applications requiring further clarifications with the supplier (approximately 3%). This is the main reason the analytical details of the information collected in this paper are not reported, however a number of collateral results of special interest can be highlighted. More specifically, the majority of the data has still not been checked internally by SOI/DPO, and therefore does not represent an official basis for assessment. However, it is believed that a preliminary presentation can provide interesting opportunities and a general encouragement to continue with the analysis activities.

5.1. A collateral result/1: Assessing the level of importance of applications

The functional size (FP) represents an important standardising factor to compare the assets software systems; however a recent proposal accepted by SOI/DPO is that of establishing a number of assessment parameters that take into account the importance of the systems based on the number of users served and on the usage frequency [6]. Therefore, the following indicators have been defined:

$$Usage\ FP = FP_{online} \times \#\ Users$$

$$Running\ FP = FP_{online} \times \#\ Users \times Usage\ frequency$$

where:

- FP_{online} is the functional size of the functions (non-batch and/or non-essential support) of the system considered;
- *# Users* is the number of users of the system considered, expressed on a numerical scale that may be staggered or "stepped" (for example: 1, 5, 10, 25, 50, 100);
- *Usage frequency* is the frequency of use of the system considered (calculated in a standardised form such as 1/average number of days interval between one use and the next).

These parameters express the real usage potential of the functions of the system under review, compared with the user base and the usage frequency, respectively. Therefore, they are suitable as useful parameters to assess the impact of change projects, of management costs correlated to the usage value, and so forth. Tab. 3 below shows an abstract of some data as an example (UFP values at 31/12/02). It's worth noting that small size applications can assume a major role by virtue of the user base (>>10) or the daily/weekly frequency, while larger size applications can have FP Usage or Running FP values of only a few tens of units. Therefore, these parameters can provide more significant assessment scales compared with only the functional size.

Application	*UFP*	*NUMBER OF USERS*	*# Standard users*	*Usage frequency*	*Standard frequency*	*FP Usage*	*Running FP*
Cultural events calendar	**253**	1	1	Daily	1	**253**	**253**
Tax records	**69**	>10	25	Annually	0.003	**1,725**	**5**
Air, water, soil quality cadastre	**2,985**	<10	5	Monthly	0.03	**14,925**	**498**
Financial Statements (Intranet)	**235**	>>10	100	Daily	1	**23,500**	**23,500**
Securities (Distrib.)	**17**	5	5	Daily	1	**85**	**85**
Council resolutions and decisions made by Directors (Intranet)	**86**	>10	25	Daily	1	**2,150**	**2,150**
Public finance (Distrib.)	**41**	>>10	100	3 times/year	0.008	**4,100**	**34**
PAT Web Periodicals	**168**	3-4	5	Monthly	0.03	**840**	**28**
Council resolution proposals (Intranet)	**47**	1	1	Daily	1	**47**	**47**
Kindergartens / schoolchildren management	**659**	5	5	Daily	1	**3,295**	**3,295**
District counters management	**433**	>10	25	Daily	1	**10,825**	**10,825**
Offence reports	**718**	2	2	Weekly	0.14	**1,436**	**205**

Table 3 Extract of the "4GL" systems measured using the IFPUG Function Point 4.0; the Unadjusted FP, FP Usage and Running FP values are highlighted.

5.2. A collateral result/2: Discovery and disposal of obsolete systems

The analysis of the interviews, carried out on the basis of the quarterly inventory proposed by the IT-supplier, highlighted a large number of systems (approximately 50 over 120) for which the PAT reference persons declared an "actual non-use". Considering that operational non-use however can be compatible with an occasional (rare) need of use, or with the preservation of the historical information contained in the application, a further examination involving a negligible effort led to the identification of "no less than" 16 applications (approximately 10% of the assets at the date of the interviews), mainly "3GL" type, released between 1985 and 1995, for which it was possible to request direct disposal, with the subsequent saving of the relative (and not irrelevant) management costs. In a number of cases disposal was accompanied by backing up the reserves of historical information managed by the obsolete systems.

6. Conclusions and future developments

We have described the implementation of the software assets project and the launch of the relative measurement process in the framework of the Autonomous Province of Trento. The importance of these software assets must be stressed not only as regards the internal knowledge and management by the principal/user (PAT/SOI), but also in terms of the greater transparency, communication and negotiating ability in relations with the supplier.

The completion of the PAT software assets scheme is foreseen in a gradual form during 2004. The completion phase will be combined naturally with the on-going management of the assets following the new software developments and enhancement maintenance activities which are currently in progress or which will be implemented during 2004.

Moreover, enhancement of the current projects database is expected to favour the implementation of a benchmarking activity, which will benefit undoubtedly from the support of the software assets project already launched.

There are numerous and very significant future developments in the research subject outlined in this paper, a number of examples are mentioned here:

- functional overlap analysis among separate systems;

- "intra-system" and "inter-system" reuse analysis, mainly among functionalities of the same system or of separate systems;
- experimenting metrics as an alternative to the IFPUG Function Points, such as the COSMIC Full Function Points;
- assessing the extension of the functional measurement method to systems that have not been measured to-date (managed typically based on a lease), for example data warehousing systems ;
- validation of the Early & Quick estimate results compared with the balance values based on standard counts;
- experimenting productivity models which take into account the significant impact of reuse, parameterisation, the intrinsic complexity and change request in development and enhancement projects, designed to optimise costs in the case of complex software systems, to improve final user satisfaction and to identify a more realistic measure of effort and consequently the costs to be paid to the IT-supplier.

7. References

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