

# POLITECNICO DI MILANO

SCUOLA DI ARCHITETTURA URBANISTICA INGEGNERIA DELLE COSTRUZIONI

Master of Science in Management of Built Environment



## Manufacturing industry facility management

CASE STUDY ANALYSIS AND IMPROVEMENTS

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## Abstract

### ENGLISH

The following work aims at analyzing the facility management (FM) of a big manufacturing industry and more specifically the contract of service outsourcing that regulates the relationship between the company that supplies the FM services and the manufacturing industry above. The document aims to analyse and describe the following macro-areas of investigation:

- outsourcing contract (tender; included service and organization of the parts);
- FM procedures (both the ones defined in the contract and the ones adapted to the effective needs);
- information system supporting the FM (management of the information and the accounting of the activities).

For each of the three sections the main criticalities and their impacts on the FM activities will be highlighted. Following this critical analysis some possible solutions will be proposed, aiming at defining guidelines for a possible redesign of the contracting activities that improve the overall FM activities.

### ITALIANO

*Il seguente lavoro si propone di analizzare dettagliatamente il facility management (FM) di una grande industria manifatturiera e in particolare il contratto di esternalizzazione dei servizi che regola il rapporto tra l'azienda fornitrice delle attività di FM e l'azienda manifatturiera di cui sopra. Il documento si propone di analizzare e descrivere le seguenti tre macro-aree di approfondimento:*

- *contratto di esternalizzazione (capitolato d'appalto; servizi inclusi e organizzazione delle parti);*
- *procedure FM (sia quelle definite dal contratto e sia quelle adattate alle necessità reali);*
- *sistema informativo a supporto del FM (la gestione delle informazioni e la consuntivazione delle attività).*

*Per ciascuna delle tre sezioni verranno evidenziate le principali criticità riscontrate con i relativi impatti sull'attività di FM. A seguito di questa analisi critica verranno proposte delle possibili soluzioni che mirano a definire delle linee guida per un possibile revisione e riorganizzazione delle attività a contratto al fine di migliorare l'intera attività di facility management.*

## Introduction

Through the years, facility management has been well debated and analysed in the built environment sector; all the aspects have been highlighted and the market has been growing ever since, and is expected to continue with the growing trend. The developing of the subject through the years has brought to use and to process of an enormous amount of knowledge that is increasing due to the facility management different domains, generating a new issue to be solved: the management of the data process and information flow management.

The knowledge of the real estate is a fundamental prerequisite for the outsourcing of the facility management (FM) services; the creation of knowledge depends from the extracted data that properly processed becomes information. Data themselves are elements, units (numbers, letters, name) that do not give any value gain unless they are processed. Information is the product of the data process and is value-adding for the whole system. As highlighted by Talamo<sup>1</sup>: “The subject of knowledge opens to a particular view within FM services, starting from the conceptual chain, that links:

- data (i.e. numbers, texts, images, etc.), that obtain meaning and value only in relation to a context and processing;
- information that is data processed according to specific goals, referred to a context and managed to be used, shared and combined;
- knowledge that is the result of applying, processing, relating, combining information in specific contexts. The process, that leads information to enter in a system able to develop knowledge, creates the actual value and competitive advantage for an organization”.

The importance of information within the FM services has increased even more with the introduction of performance based contracts (global service); the definition the goals and the measurement of the performance requires a bigger amount of information not only to execute the FM activities but, through feedback information, to evaluate and monitor the contractors. To correctly manage the set of information and knowledge that stems from the process it is necessary that the relationship between the parties of the agreement moves within certain defined boundaries that help the efficiency of the information flow, the traceability and the

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1 TALAMO C. & BONANOMI M. – KNOWLEDGE MANAGEMENT AND INFORMATION TOOLS FOR BUILDING MAINTENANCE AND FACILITY MANAGEMENT; MILAN – SPRINGER, 2015; P.6

execution of the activities itself. These boundaries are defined through procedures and methods that represent the “rules of engagement” of the relationship; these rules should be clear, simple and affordable for both parties, they are binding for the Supplier but also for the Client and, in theory, are supposed to allow every stakeholder of the contract to be considered in the contracting activities.

Many authors studied various aspects and defined efficient methodologies to approach the situations that raised from the information management issue; while the scientific research is heavily pointing towards the BIM<sup>2</sup>-based systems for facility management<sup>3</sup>, demonstrating its potential impact on efficiency, the reality of many facilities in Italy continues to struggle to introduce an efficient computerized information management system, due to the use of old buildings, old-school management policies and poor knowledge of the up-sides of a proper facility management technology implementation.

This document analyses a case study of a global service contract in a manufacturing industry facility, describing the situation, the tender, the rules of engagement and the information management both for the execution and the accounting of the activities. The aim is to understand the criticalities that arise from the relationship between the contractor and the client in the “as-is” situation and propose possible guidelines that improve the relationship and avoids the repetition of the criticalities in a future redesign of the tender.

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2 EN ISO 29481-1 BUILDING INFORMATION MODELS — INFORMATION DELIVERY MANUAL; BUILDING INFORMATION MODELLING BIM: USE OF A SHARED DIGITAL REPRESENTATION OF A BUILT OBJECT (INCLUDING BUILDINGS, BRIDGES, ROADS, PROCESS PLANTS, ETC.) TO FACILITATE DESIGN, CONSTRUCTION AND OPERATION PROCESSES TO FORM A RELIABLE BASIS FOR DECISIONS

3 SHALABI F. S.M.ASCE AND TURKAN Y. AFF.M.ASCE – IFC BIM-BASED FACILITY MANAGEMENT APPROACH TO OPTIMIZE DATA COLLECTION FOR CORRECTIVE MAINTENANCE – JOURNAL OF PERFORMANCE OF CONSTRUCTED FACILITIES, VOLUME 31, ISSUE 1, 2017

## 1. Case study analysis

### 1. Introduction to the tender

The analysed case is a Facility Management agreement (EN 15221/2006)<sup>4</sup> in the form of Global Service contract.

A global service contract is a specific contracting typology for the supply of facility management services that have the particularity of basing the economic compensation, that the client acknowledges to the supplier, partially or totally based on the measurement of the supplier's performance on specific results that must be achieved<sup>5</sup>.

The Global Service contract is object of the norm UNI 10685/2007<sup>6</sup>, that explicitly highlights the aspects that a Global Service maintenance contract must have:

1. The client handles to a third party, for a specific period, the maintenance of a good with the aim to:
  - a. Maintain it in the requested condition level;
  - b. Obtain the willingness to produce and/or carry out the requested service;
  - c. Have access to ameliorative proposals that aim to increase the technical characteristic of the good, its willingness to produce and reduce the cost of the service;
2. The supplier grants the conduction of the good according to the parameters and procedures that have been agreed with the client;
3. The supplier is responsible of the decisions in design, plan, management and execution of the activities, apart with what agreed jointly with the client;
4. The supplier guarantees the achievement of the agreed performance levels (SLA<sup>7</sup>);

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4 EN 15221-1:2006; 2.7 FACILITY MANAGEMENT AGREEMENT – “WRITTEN OR ORAL AGREEMENT STATING THE TERMS AND CONDITIONS FOR PROVISION OF FACILITY SERVICES BETWEEN A CLIENT AND AN INTERNAL OR EXTERNAL SERVICE PROVIDER”

5 TRONCONI O., CIARAMELLA A. – FACILITY MANAGEMENT; PROGETTARE, MISURARE, GESTIRE E REMUNERARE I SERVIZI; MILAN – FRANCOANGELI, 2014; P.70

6 UNI 10685:2007 CRITERIA FOR THE FORMULATION OF A CONTRACT BASED ON PERFORMANCE (GLOBAL SERVICE)

7 EN 15221-1:2006; 2.15 SERVICE LEVEL AGREEMENT (SLA) – “AGREEMENT BETWEEN THE CLIENT OR CUSTOMER AND THE SERVICE PROVIDER ON PERFORMANCE, MEASUREMENT AND CONDITIONS OF SERVICES DELIVERY”

5. The supplier gives the client the sufficient documentation and access to information to allow him to continue to have knowledge on the technical-economic aspects of the good, evaluate whether the supplier operates within specifications of the tender and global service contract;
6. The economic compensation is based on the results achieved;
7. The measurement of the results is based on pre-arranged indicators measured with agreed methodologies (KPI<sup>8</sup>).

The norm UNI 10685:2007 refers to general maintenance contracts and is not specific for the building maintenance field, still the characteristics of the norm can be considered sufficient for the field itself therefore the norm can be considered fully valid.

In this case, the contract as for object the supply of integrated services for the management, maintenance and cleaning of buildings, mainly used as offices but could comprehend locker rooms, laboratories, archives and other kind of civil areas, in use by any means by the Client. The duration of the contract is of 3 (three) years with a possibility of a 2 (two) year extension starting from July 2014.

The contract requires different kind of activities that can be divided as:

- Mason works, Carpentry and blacksmith's works; all works that contemplate the maintenance of the Client's building structure and finishing
- Electrical system; all works that grant the correct functioning of the electrical supply in the Client's buildings (object the tender), the maintenance of the systems and electrical equipment that are listed in the tender.
- Telephone network and data transmission; all the works that contemplate the maintenance of the telephonic network from the distribution frame, network side, to the users and the data transmission from the rack cabinets to the user plug.
- Water and sanitary system; all the works that maintain the full functionality of the systems, their availability and the user's safety.
- HVAC system; all the works that maintain the continuous functionality of the systems, their availability, the user's safety and the adequate thermal comfort for the users – the

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8 EN 15221-3:2006; 3.1.13 KEY PERFORMANCE INDICATOR (KPI) – "MEASURE THAT PROVIDES ESSENTIAL INFORMATION ABOUT PERFORMANCE OF FACILITY SERVICES DELIVERY"



Supplier is the *liable third party* in the management of the heating system according to Italian law and should respect all legislations regarding the registration, conduction and functioning of the HVAC systems.

- Cleaning Services; all the cleaning related services of all offices, department booths, locker rooms, toilets and bathrooms of the Client's facilities

All the above activities must be perfectly done according to the existing norms and standards of maintenance and further evolutions of the norms.

## I. Client

The Client is a worldwide leading manufacturer in the steel industry that has several production facilities in Italy. The contract is based in the headquarters that is in Italy and manages all the productive facilities based on the Italian territory: 5 in northern Italy, one of which the headquarters of the company, and 1 in center Italy. [Fig.1]

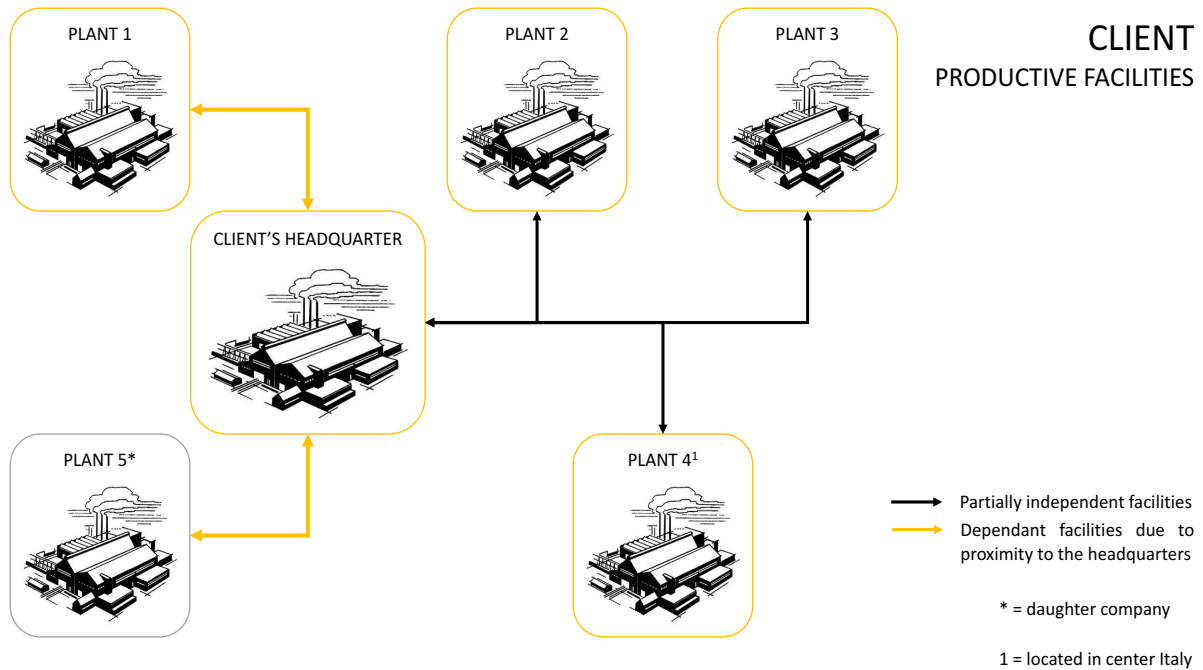


Fig. 1 - Structure of the Client's facility (source: J. Carrara)

The headquarters, built in 1910 by the Client's founder, is a big 47.000 sq.m. facility with 20.000 sq.m. of office area and 3 productive areas that operate on 3 shifts all year long. The production in the headquarters is the core of the Client's production, and, along with the managerial offices, make the plant the most important for the Client. Plant 1 and Plant 5 (technically a daughter company) are in the same town of the headquarters and so they can be assumed as a direct extension of it. The other plants are peripheral facilities that produce for a niche market or components for a limited market share.

The dimensions of the plants, shown in the following table [Tab.1], underline the importance of the headquarters over the other peripheral sites.

LOCATION	Connective			Archive	Sanitary	Locker	Dept.	TOTAL
	Offices	areas	Classrooms	– lab	services	rooms	Booths	
Headquarter	20444	7935	3449	7565	2953	3725		46681
Plant 1	1767	688		969	422	506	93	4445
Plant 2	2070	329	139	215	462	1174		4389
Plant 3	1086	236	221	100	220	375		2238
Plant 4	1573	433	279	1104	413	1019	536	5357

Tab. 1 - Facilities dimension [m2] (source: tender)

To manage non-core activities the Client historically outsourced resources from external specialized suppliers that could properly satisfy the needs without interfering with the core production.

For this tender, the Client requires structured supplier that can take care of all the facility management and cleaning activities in all its facilities and all the other buildings or locations that are Client’s property or under the Client’s management.

In the last years, due to a global economic crisis of the sector the Client suffered a drastic revenue diminishing, forcing severe staff cuts in all the areas of business. The headquarters, once home of nearly twenty-five hundred workers, remained with little more than a thousand; many buildings of the facilities have been dismissed or partially closed. The sufferance then spilled on supply contracts that where rearranged and reduced in all areas.

## II. Supplier

The Supplier is an international service provider that operates worldwide in facility management, energy management and energy production. For this tender, the supplier organized a workshop that is situated inside the Client's headquarters facility with governance and operative figures. The personnel for this workshop has been recruited from the previous contracting supplier and have worked for the Client for the past 10 to 20 years, depending on the resource. They were integrated in this contract by the Supplier because they were considered to have an intangible knowledge of the Client's structures and personnel that could be an important asset in the execution of the interventions.

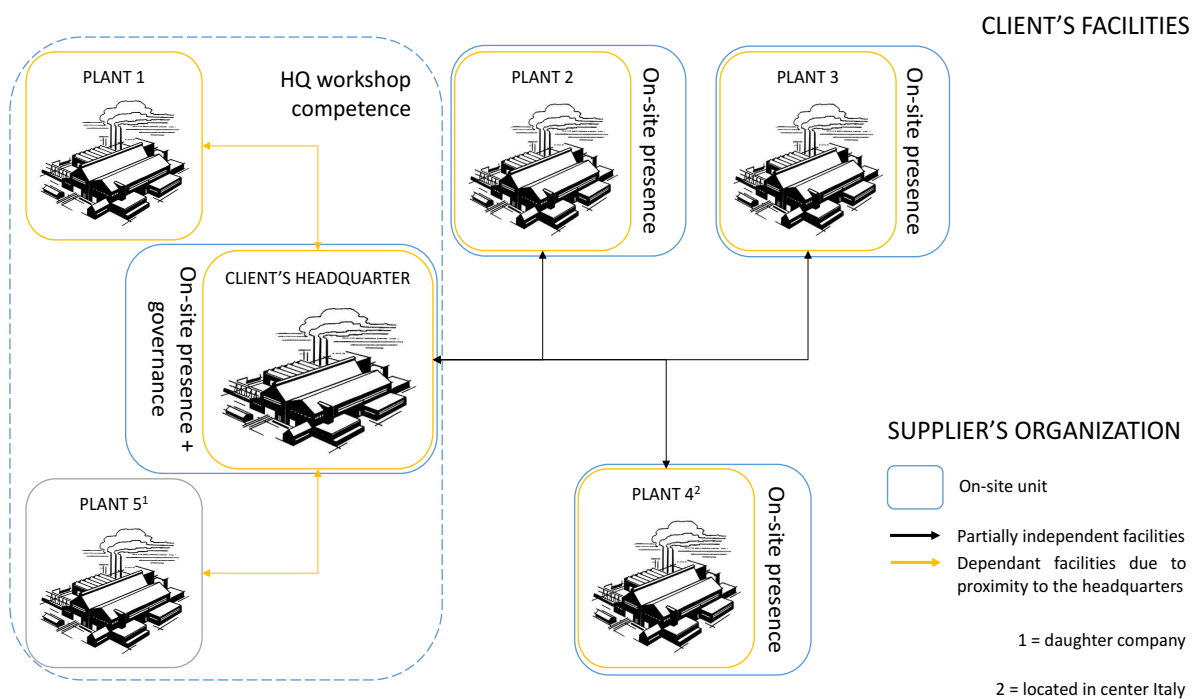


Fig. 2 - Supplier's organization on the Client's plants (source: J. Carrara)

The Supplier, as showed in the above image [Fig.2], organized the contract focusing on the Client's headquarters where most of the activities are requested; the central workshop, where the governance structure of the Supplier is situated, directly manages all the activities of the headquarters facility and plant 1 and plant 5 with the on-site resources, all the preventive maintenance activities of the assets of the contract and has strategical importance all the units present in the Client's facilities. For all the other peripheral sites the Supplier organized an on-site presence for all the management and executions of the on-fee activities and executes, with the resources available in the central workshop, all other more complex interventions.

## 2. Service provided

The services provided by the contract for the fulfillment of the maintenance activities are subdivided in Governance and Operative Services, that include on-fee and extra-fee activities, management of an on-site unit and the structure of an on-call service. The Supplier is responsible for the fulfillment and quality of all the services provided, the Client can verify the services in every moment of the contracting period.

After the downsizing of the contract amount, required by the Client, the Supplier was forced to adapt its governance and operative team to maintain the required service level towards the client and to adapt to the new internal budget constraints, the changes have significantly modified the structure and the internal equilibrium of the Supplier.

### I. Governance

As governance is intended all those activities that contribute to a correct organization and execution of the maintenance works. The governance structure can be organized by the Supplier at will to satisfy the needs of the client; it must ensure an effective planning, programming and strategical management support for an efficient supply of the services. The governance service relates with the client on daily basis through, but not solely, an informative tool that manages the operative services provided, gives feedback to the Client, manages the charged cost to the Client.

For this specific tender Client and Supplier have agreed to maintain the same maintenance personnel that has been working for the Client, with different suppliers, for the last 15 to 25 years. At the start of the contracting period, as Governance structure, the Supplier organized the office staff with a Contract Manager and four other staff members, all of which were coming from the previous supplier. The organization of the office was the following:

- I. The Contract Manager has a strategical role, relates with the Client's facility manager and argues on contract matters with the Client. He organizes and monitors the office work and directly organizes the work of sub-contractors, carpenters, blacksmiths and masons [Fig.3]; he is responsible for the accounting of the workshop and reports to the Supplier's area manager that is not considered a figure of the contract.
- II. The secretary takes care of administrative documents and permissions that allow a correct execution of the works of the workshop; facility entrance permissions, car

insurance, courses, management of internal bureaucracy and orders towards external sub-suppliers.

- III. The remaining three assistant contract managers manage and supervise the operative work of some technicians of the on-site unit [Fig.3]: one assistant for electricians, one for plumbers and one for porters. These figures report directly to the Contract Manager, participate in the execution of critical interventions and have the responsibility for all the interventions of their managed squad.
- IV. The cleaning manager, who was for the previous supplier an assistant manager for cleaning services, was hired by the Client's sub-contractor that run all the cleaning services. Despite being an external entity for the Supplier, this resource, having worked in the workshop for the previous 20 years, must be considered as part of the office staff at par with the assistant contract managers. This figure reports to the Contract Manager and to the sub-contracting competent manager.

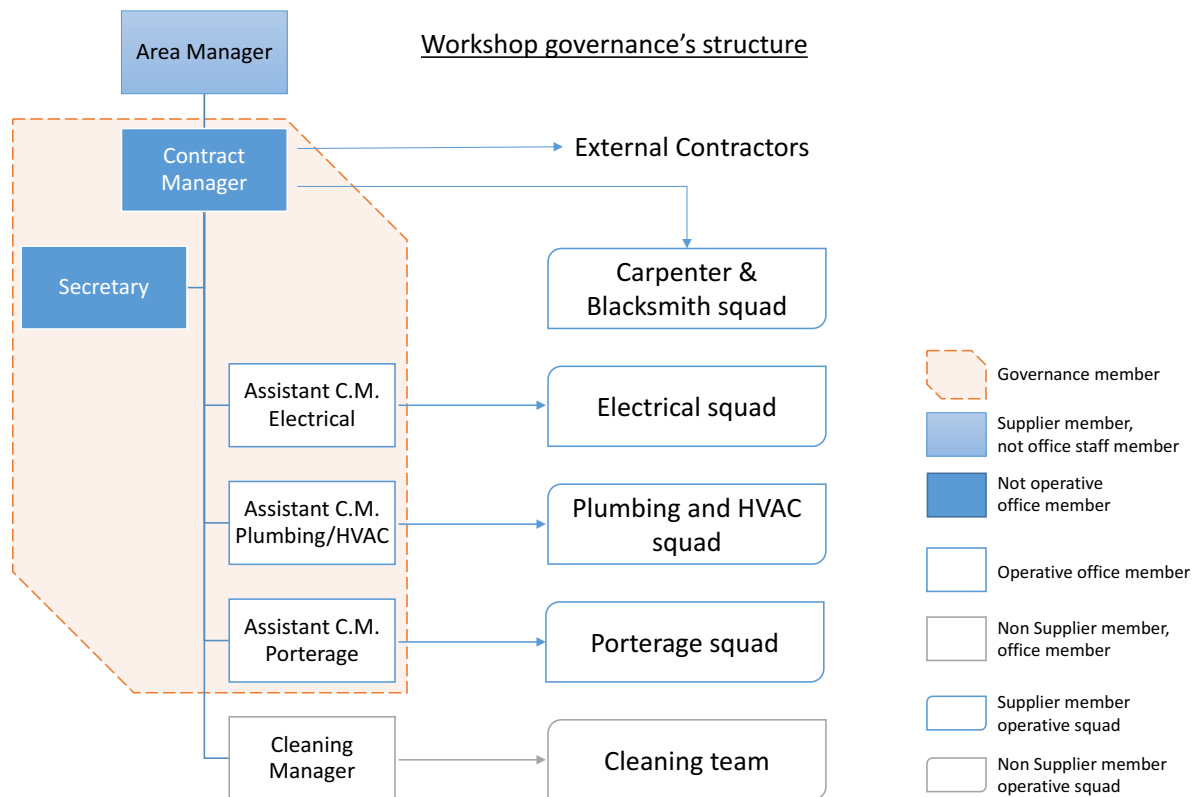


Fig. 3 - Governance in the Supplier's organization (source: J. Carrara)

## II. Operative services

The Supplier is free to structure the workshop with internal or external workforce, being responsible for the works executed. For some activities, the Client requires that the intervention of specialized companies that will be managed and supported by the Supplier.

Every service offered by the supplier is divided, with an accounting criterion, in on-fee activity (whether the intervention is intended included in the monthly fee) and extra-fee activity (whether the intervention should be accounted out of the monthly fee).

### *On-site unit*

The Supplier has the duty to grant an on-site unit of operative workers of various specializations in the facility within the working hours (from 8.00 to 17.00) continuously. The structure of the on-site unit is entirely up to the Supplier; the Client imposed that during the entire duration of the contract the worker turnover in the on-site unit that may not exceed 50% of the resources.

The on-site unit's structure should comprehend:

- Contract Manager  
that operates with the high decision-making autonomy and figures has the only contact towards the Client for issues regarding the Tender and strategical decisions
- Site Manager  
to coordinate all the activities that are provided by the contract, monitors the work progress of the MP and work requests, verifies the quality of the work and the perceived Client's satisfaction. The Site Manager operates consistently with the indications given by the Contract Manager.
- An operational team composed by sufficient workers that can operate to satisfy the following work requests: electrical works, network assistance, plumbing works, HVAC issues, general carpentry and masonry works, portorage.

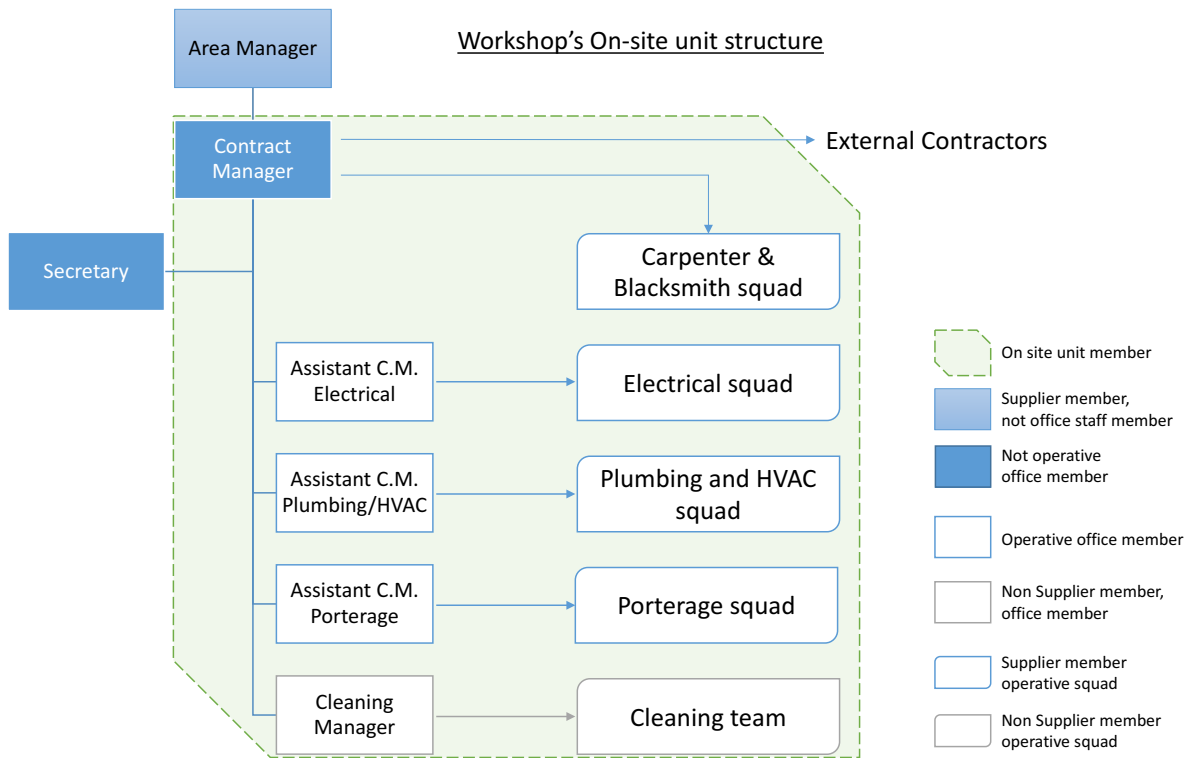


Fig. 4 - On-site unit in the Supplier's organization (source: J. Carrara)

The on-site unit's work is intended as included in the fee and it provides the following services:

- manage and conduction of the systems
- fault research and prompt intervention
- preventive maintenance
- corrective maintenance

### On-call service

For critical issues that may happen out of the on-site unit time competence the Client and the Supplier have structured an on-call service. This service has the aim to promptly intervene in case of high severity and emergency faults or failure in the systems and to restore the functionality and safety as soon as possible, even with temporary solutions if necessary. The completion of the intervention may be done in a second moment out of the on-call regime.

The agreement between Client and Supplier on the matter has decided that the on-call service is intended only on electrical, plumbing and HVAC systems that is granted 24/7 by its technicians. The supplier organized its operative team so that one technician of the electrical squad and one of the plumbing/HVAC squad are always available on call.



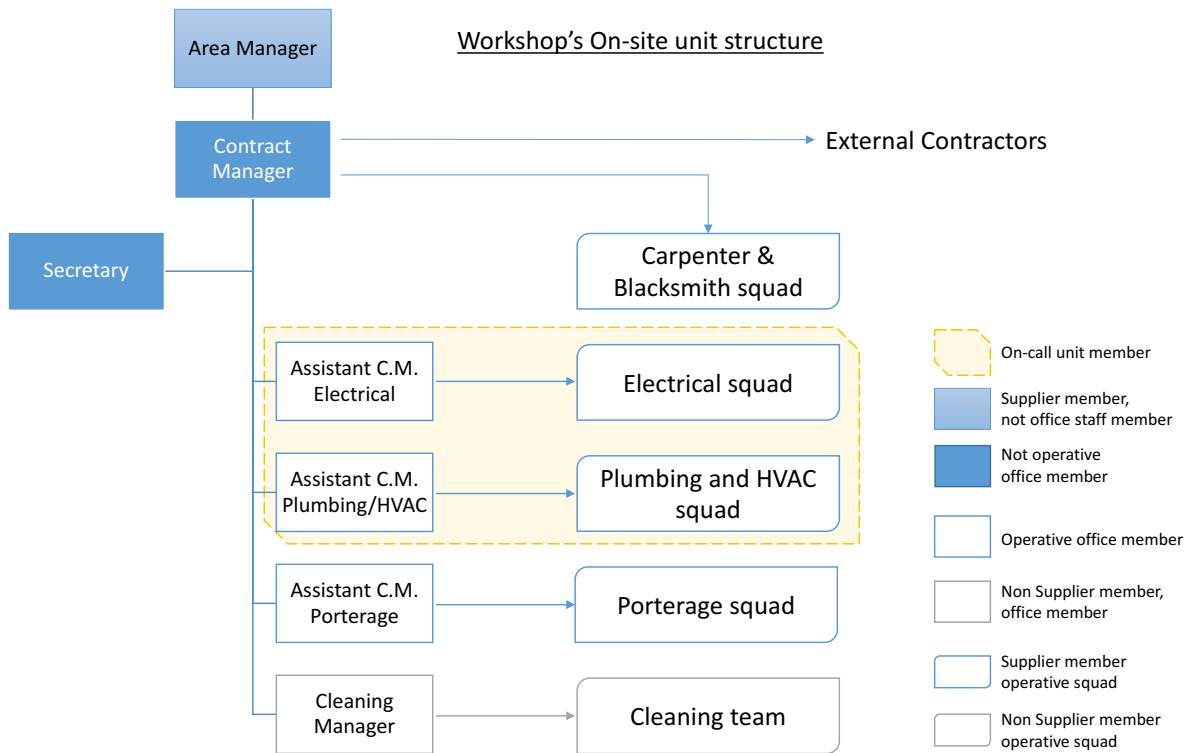


Fig. 5 - On-call unit in the Supplier's organization (source: J. Carrara)

The agreement between Client and Supplier defines the minimum economical consideration that is perceived by the Supplier for on-call activities and the maximum intervention time for the technician. This agreement does not consider the different activities that are available on-call (plumbing/HVAC and electrical) and there is no specific payment line for this activity. This may result in complications when paying the on-call services.

### On-fee activities

The on-fee activities are interventions that the Supplier executes, on some specific Client's assets, that are already included in the monthly fee, without charging any extra cost on the Client. Therefore, these activities are intended, according to UNI 10992, as ordinary maintenance<sup>9</sup> and can be divided in the following typologies:

9 UNI 10992:2002 - MAINTENANCE BUDGET FOR MANUFACTURERS AND SUPPLIERS OF PRODUCTS AND SERVICES - GUIDELINES FOR THE DEFINITION, APPROVAL, MANAGEMENT AND CHECK; CHAP. 3.26 ORDINARY MAINTENANCE.

- management and conduction of the building systems – activities that aim to grant the continuity and full functionality of the office works; the Supplier is entitled to organize its operational service for the condition monitoring<sup>10</sup>;
- preventive planned maintenance<sup>11,12</sup> - interventions that aim at containing the number of system failures on the maintained assets; this activity is issued through the approved annual Maintenance Plan (MP);
- corrective maintenance – interventions that restore the eventual faults/failures in the Client's assets that are detected by the Supplier, the Client or a generic user, without the substitution of critical elements of the system/building.

### *Extra-fee activities*

Are extraordinary supplementary benefits that are supplied on request by the Client, or by necessity/opportunity, that are paid by the Client in addition to the monthly fee. Every extra-fee activity must be approved by the Client through a work order and a procedure that is decided by both the Client and Supplier.

The activities are divided in two different categories:

- Extraordinary maintenance<sup>13</sup> – are interventions aimed to restore functionality of a system through the substitution of a critical element of it or a highly-specialized activity that is not included in the monthly fee;
- Ameliorative maintenance – are interventions aimed to improve the quality or efficiency or functionality of the maintained systems, without changing the value of the asset<sup>14</sup>.

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10 EN 13306:2015 – MAINTENANCE - MAINTENANCE TERMINOLOGY; CHAP. 8.2 CONDITION MONITORING: ACTIVITY, PERFORMED EITHER MANUALLY OR AUTOMATICALLY, INTENDED TO MEASURE AT PREDETERMINED INTERVALS THE CHARACTERISTICS AND PARAMETERS OF THE ACTUAL STATE OF THE ELEMENT

11 EN 13306:2015; 7.1 – MAINTENANCE TYPES, PREVENTIVE MAINTENANCE.

12 EN 13306:2015; 7.2 – MAINTENANCE TYPES, PREDETERMINED MAINTENANCE.

13 UNI 10992:2002 – MAINTENANCE BUDGET FOR MANUFACTURERS AND SUPPLIERS OF PRODUCTS AND SERVICES - GUIDELINES FOR THE DEFINITION, APPROVAL, MANAGEMENT AND CHECK; CHAP. 3.28 EXTRA-ORDINARY MAINTENANCE

14 MOLINARI C. – PROCEDIMENTI E METODI DELLA MANUTENZIONE EDILIZIA, VOL.1: LA MANUTENZIONE COME REQUISITO DI PROGETTO; NAPOLI – SISTEMI EDITORIALI, 2002; CHAP. 2.1, P.133

### Cleaning services

The cleaning services are managed through an annual cleaning plan of the facility's locations that describes the works and the schedules that the Supplier must respect. All the cleaning activities included by the cleaning plan are paid by a cleaning fee and are considered as on fee activities; every other cleaning request that is not included in the annual cleaning plan must be considered an extra-fee activity and therefore charged separately by the client.

In this specific case, all the activities linked to the cleaning services, for all the client's facilities, have been outsourced to an external specialized subcontractor that carries out the cleaning plan and the cleaning requests that are issued by the client. The cleaning subcontractor has organized itself with a cleaning manager, which is both an operative and tactical figure, and three team managers for the facilities spread in northern and center Italy; every one of these figures manages an operative team for each of the client's facilities.

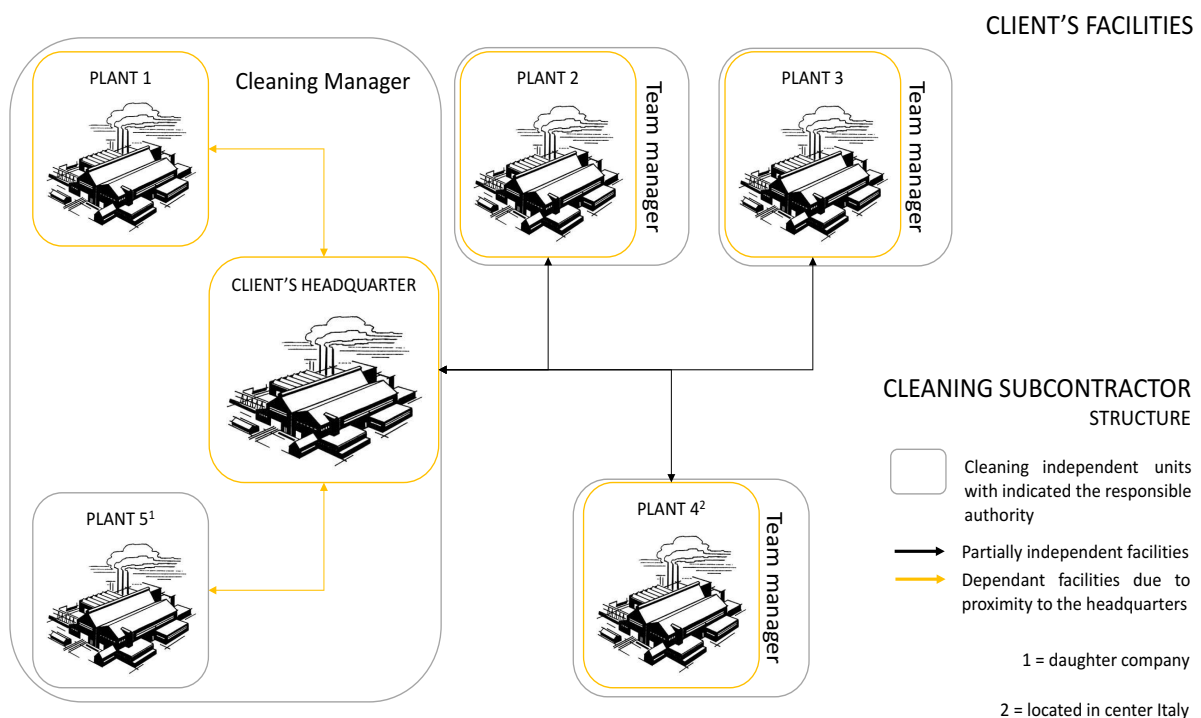


Fig. 6 - Cleaning subcontractor's organization in the Client's facilities (source: J. Carrara)

The cleaning manager that has office in the workshop manages even two other production facilities that are in the proximity of the headquarters, refers directly to the Contract Manager and is considered the main referent towards the Supplier on an operational level. Every other team manager runs the activities independently and reports to the cleaning manager or directly to the subcontractor's contract manager.

Due the cleaning operative team has direct contact with areas and personnel of the facility, within the duties of a cleaning resource, apart from the cleaning service itself, is to signal faults or general problems that are noticed during the cleaning activities. The operator writes down a report where he/she declares the fault detected and delivers it to the cleaning manager, the cleaning manager gives notice of the detected faults, by handing the written reports and/or any other details of the problem, to the assistant contract managers to request the intervention.

### III. Contract downsizing

Due to a change of the client’s economic situation the contract has been revised and modified several times within the first year and half, its value has now reached 20% of the initial economic value.

Such a substantial reduction of the total amount of the contract has been made on the budgets for Governance, MP assets and cleaning annual plan: The Governance has been reduced drastically by approximately 60%, from the initial 5 employees as office staff, the Supplier had to reduce its workforce to 2, Contract Manager included. All the maintenance plan has been downsized reducing the number of assets maintained by the Supplier and reducing the maintenance activities to minimum legal requirements; same treatment was reserved for the cleaning plan, who saw a critical reduction of the cleaning activities and most of all frequencies, most areas were eliminated from the cleaning fee and their cleaning became an extra fee activity made only on request of the Client.

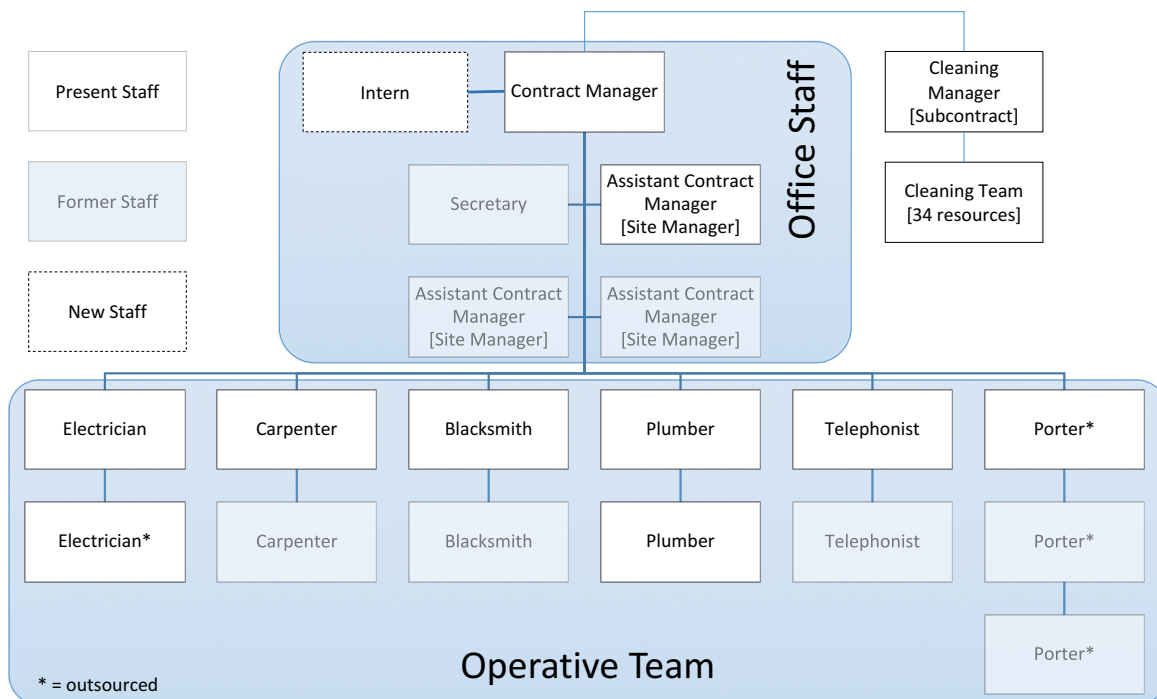


Fig. 7 - Supplier's organization before and after the contract downsizing (source: J. Carrara)

At the beginning of the contracting period the Supplier had a structure for its employees as the one shown in the image above. [Fig.7]

The Office staff was structured with a Contract Manager, three assistants that had each a specialization (porters, plumbing, electrical works), the cleaning manager and a secretary; the reduction of the contract value made the governance structure economically unsustainable

and forced the Supplier, under the supervision of the Client, to operate staff cuts, leaving the Contract Manager and a single Assistant to manage all the office duties of the workshop along with the cleaning manager (who is a subcontractor). Also, the Operative Team suffered a consistent reduction by downsizing from 13 operators to 8 (of which 2 outsourced) that implicated a distribution of duties between the operators that were demanded a higher level of flexibility in their specializations.

Such a drastic change in its structure required for the Supplier to adapt and modify both the external relations with the Client and, above all, internal dynamics between its staff.

The Supplier rearranged himself with the reduced personnel and found the adequate compromises between execution efficiency and economic efficiency to continuously run the workshop.

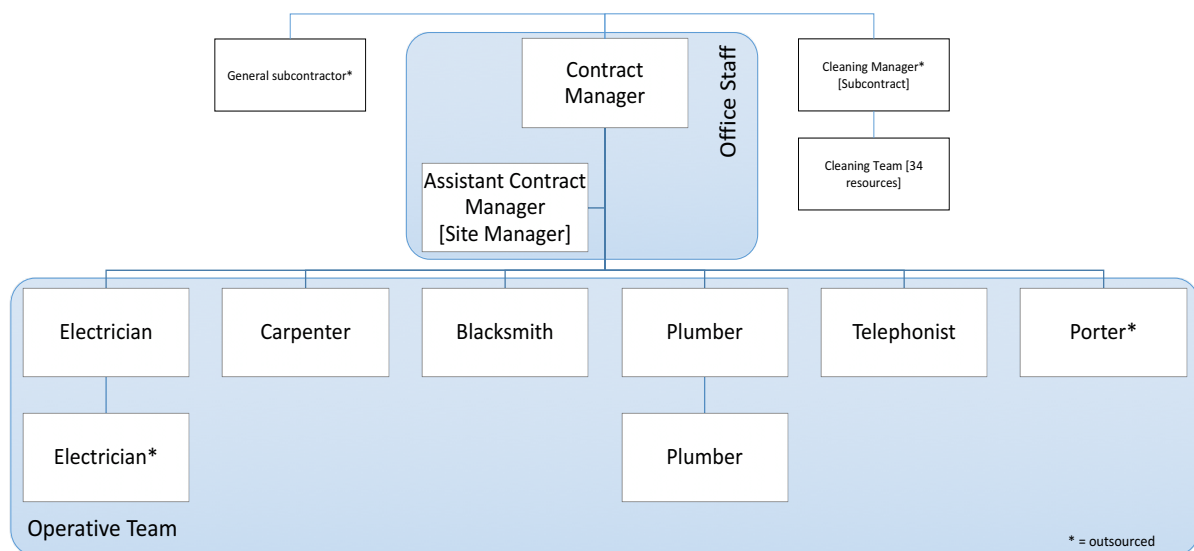


Fig. 8 - New Supplier's structure (source: J. Carrara)

The Assistant Contract Manager that was left took care all the administrative issues of the workshop and the costing of the interventions, the Contract Manager followed the operative on-site unit and the activities of the subcontractors, the on-site unit managed their own work according to their planning ability.

This structure managed to run the workshop and the relationship with the Client due to the high knowledge of the facility from all the members of the Supplier's team but created huge uncertainty regarding the status of the executed work and the lead time for an intervention.

There has been a further changing of the governance structure that allowed the Supplier to regain an efficient system of information management and economic performance. The

changes implemented were a substitution of the assistant contract manager and the insertion of an Intern in the governance structure. The Intern, with similar authority to the Assistant Contract Manager, studied the procedures and processes, both internal to the Supplier and external towards the Client, with the aim to increase the efficiency of the information flow and prepare new procedures for future contract negotiations that are scheduled at the end of the first contracting period of three years before the two-year extension specified in the contract.

### 3. Organization and Structure

According to EN 15221 standard, facility management operates on three levels on interaction: strategical, tactical and operational<sup>15</sup>. The facility management agreements are divided in two categories whether they operate on all three levels or only on tactical and operational level<sup>16</sup>. In the analysed case to succeed in the execution of the activities of the contract, the Facility Management, for the complexity and dimensions of the Client's real estate, shall be synchronized with the mission, the vision and the objectives of the Client's organization. To do so the organization and structure of the figures involved in the contract must operate on all three levels of the facility management:

1. Strategical = define strategies, service level agreements (SLA), key performance indicators (KPI), methods or procedures for the tactical and operative levels and monitor the activities;
2. Tactical = plan, control and evaluate the work of the operative team, maintain the service level according to SLA, report to the strategical level;
3. Operational = execute the requested activity according to the methods and procedures required by the agreements, norms and regulations.

#### I. Command center

"Taking into account different case studies, it is fair to assert that neither in the literature, nor in regulations or contract practices, it can be found a univocal, shared and consolidated interpretation of the command center".<sup>17</sup>

The command center could be defined as a strategical body that manages the contract and supports the supply of the operative services that are object of the contract.

The command center has a coordination function, manages information flows, request planning and planning process, monitors and controls the service. The main goal of the command center is to ensure the achievement of the service levels that are demanded by the

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15 EN 15221 – 1:2006; ANNEX A.4 LEVELS OF INTERACTION

16 EN 15221 – 2:2006; 5.2 ORGANIZATIONAL NEEDS

17 TALAMO C., BONANOMI M. – KNOWLEDGE MANAGEMENT AND INFORMATION TOOLS FOR BUILDING MAINTENANCE AND FACILITY MANAGEMENT – MILAN, SPRINGER, 2015; CHAP. 5.1, P.134



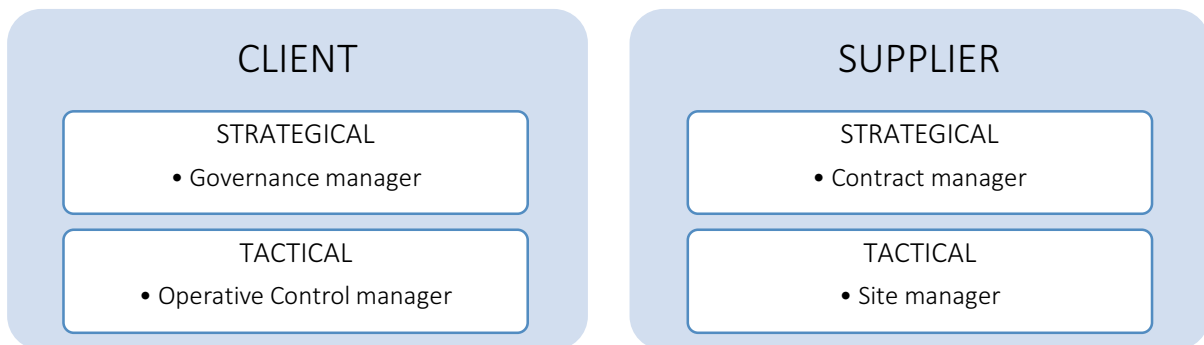
Client through the integrated service, object of the contract, and a correct sharing of information between Client and Supplier.

The command center, when correctly structures, should represents a meeting point for the parts of the contract since it is composed of representatives of both the Client and the Supplier.<sup>18</sup>

The analysed tender does not explicitly highlight a defined command center for the activities leaving a big gap in the structure of the relationship between the parts; on the other hand, it describes the key figures that should manage the relationship between Client and Supplier divided in on a strategical and operative level.

The absence of a command center could be perceived by the Supplier as a lack of a unique responsible body that manages the various activities of the contract, specifically on the definition of the processes and the monitoring and control of the service.

The components highlighted in the tender, and described in the following paragraph, can be represented in a simplified manner in the below chart. [Tab.2]



Tab. 2 - Figures that operate in the relationship, defined by the tender (source: tender)

The Client figures are entitled to monitor the activities of the Supplier by organizing two audits a month on the MP activities. Through the audits the Client verifies the correct execution of the scheduled activities, detects delays and misconducts, verifies the correct archivation of the MP work orders.

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18 TRONCONI O., CIARAMELLA A. - FACILITY MANAGEMENT; PROGETTARE, MISURARE, GESTIRE E REMUNERARE I SERVIZI; MILAN – FRANCOANGELI, 2014; P.254

## II. Figures involved in the contract relationship

### *Strategical level*

On a strategical level the figures involved are the Contract Manager and the Governance Manager; they are entitled to control and analyse the governance service of the contract by economical means and performance measurements.

STRATEGIC FIGURES OF THE CONTRACT	
Governance Manager / Facility Manager	Contract Manager
The Governance Manager is nominated by the Client and is the only referent for the Contract Manager for all strategical and planning aspects. Has a high professional competence and is responsible for the approval of the Maintenance Plan	The Contract Manager is nominated by the Supplier as the only governance figure towards the Client. This figure should be responsible for the governance structure of the Supplier and for every decision made by it.

There is no specific required qualification or license for these figure; the Supplier is free to select the preferred candidate without limitations provided that the figure has autonomy in its decision-making tasks and in the relationship with the Facility Manager.

To evaluate the performance, the Client is entitled to ask for reports and run audits on the executed activities to monitor the service level of the Supplier. The figures of the strategical level have the duty to define the procedures, service levels agreements (SLA), the key performance indicators (KPI) to measure them and their correct use in the auditing process; they also decide who and when reports should be issued and the technical aspects that they should contain or highlight. This figures at this level should both have proven technical knowledge on the built environment and project management; they can be assistant by the figures in the tactical level or by assistant facility managers that are not involved in the tactical duties. The difference that stems from the two parts is the approach towards the activities: The contract manager is a technical figure that from technical aspects dialogues on economical and strategical issues involving the contract; the Facility Manager operates in an opposite way, being a managerial figure, starts from the economical-managerial considerations to dialogue on technical aspects. This dialogue can be productive only whether the two counterparts have sufficient knowledge on both management and technicalities (given by a technical degree or proven track record in a similar role).

*Tactical level*

The tactical figures have the duty to coordinate, organize and control the activities regarding the Operative Services of the contract in compliance with the strategical requirements.

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TACTICAL FIGURES OF THE CONTRACT

Operative Control Manager	Site Manager
Nominated by the Client as the tactical figure who is responsible of the relationship with the Supplier. Controls the ongoing activities, issues work requests and verifies the quality of the execution	Nominated by the Supplier; coordinates and controls the work of the operative team. Manages the operative information flow towards the Client in accordance with the Contract Manager

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There is no required qualification or license for these figure; the Supplier is free to select the preferred candidate without limitations provided that the figure has autonomy in its tactical duties and reports to the Contract Manager. The relationship between the tactical counterparts should be structured by the strategical figures through defined procedures and processes that govern the relationship.

The figures at this level will need specific technical knowledge on the services provided by the contract since they are intended to supervise the work and evaluate the quality of it. The Site Manager has the duty to coordinate the on-site team and provided the respect the strategical guidelines defined by the strategical figures in the maintenance procedures and on the maintenance activities; the figure will be frequently involved in the evaluation of the work, site inspections, technical decision making on all aspects of the contracting activities and could be directly execute interventions when needed. The Contract Manager can provide its internal structure with different Site Managers with different competences to cover all areas of knowledge required by the contract. The Operative Control Manager has the main duty to monitor the work of the Supplier’s activities. The figure dialogues directly with the site manager, not with the operative team, for the definition, the technical requirements and time schedule of the interventions. The figure must have a strong technical knowledge on the activities that are monitored to efficiently structure the dialogue with its counterpart. The Facility Manager can structure its office with different Operative Control Managers with different competences to cover all areas of knowledge required by the contract.

### III. The Client's organization

The main characteristic of this case study is the dimensions of the facilities that are included in the contract; the headquarters of the Client is a nearly 47.000 m<sup>2</sup> site that operates both as production facility and office headquarters; moreover, the Client has 2 other production sites of approximately 4.500 m<sup>2</sup> and 2.000 m<sup>2</sup> in the proximity of the primary site increasing the total area managed by the headquarters facility management to 54.000 sq.m.. To manage such a big area the Client has divided its facility management internal structure in different entities that are independent from one another. Every FM entity has a specific competence within this contract and can create requests to the Supplier independently from the other.

The different FM entities are divided in:

#### *Civil Facility Management (Civil FM)*

The authority covers all the civil buildings of the facility that are not directly connected to the production plants such as offices, warehouses, r&d, classrooms, cafeteria, and all related service areas. This entity can issue requests to the Supplier regarding all the plants of the Client and is the main strategical and tactical counterpart of the Supplier.

Within the Civil FM offices resides the Client's Facility Manager that, according to the contract, should be the only strategical figure that relates with the Supplier. Along with the Facility Manager the office holds the operative control managers that monitor the activities of all the suppliers that operate in the facility for the entity; the operative control managers are 4 and have organized to cover all the competences of the entity: civil maintenance activities (done by the Supplier), ecological services, cafeteria/canteen services.

#### *The Industrial Maintenance*

The authority covers all those buildings, department booths, crane cabins and spaces that are directly connected with the production plants along with the production systems. This entity covers all the issues regarding the maintenance of the production areas of the Client's headquarter. The entity mainly operates with several suppliers because the assets managed are special systems and equipment for the production areas. The office is composed of a maintenance manager that does not interact with the Supplier and assistant who has the specific duty of interacting with the civil maintenance suppliers; this assistant as a role like the operative control manager but can discuss strategical issues directly with the Supplier when they arise.

### The Informative Services

The authority is responsible for the maintenance of the information system of the facility, data transmission and telephone network. This entity covers all the facilities of the Client and has at his disposal a full-time operator for its requests.

This entity is represented mainly by the data center of the Client. The IT manager of the data center is considered the operative control manager of the entity and operates with a decision-taking authority that is comparable to the assistant maintenance manager for the industrial maintenance entity.

For the Supplier, the management of the services towards this entity is completely in the hands of the operator that interfaces full-time directly with the Client.

The FM entities dialogue with the Supplier and request interventions on behalf of the remaining Client's entities that operate in the Client's facilities. Every FM entity is independent from the other and has one or more tactical figures that operate as Operative Control Manager for the Client; the only Facility Manager / Governance Manager is found in the Civil FM entity but has poor authority on the other entities. Every single entity has an independent spending cost and can relate with the Supplier differently according to characteristics, needs, agreements and will. The relation is as shown in the following image. [Fig.9]

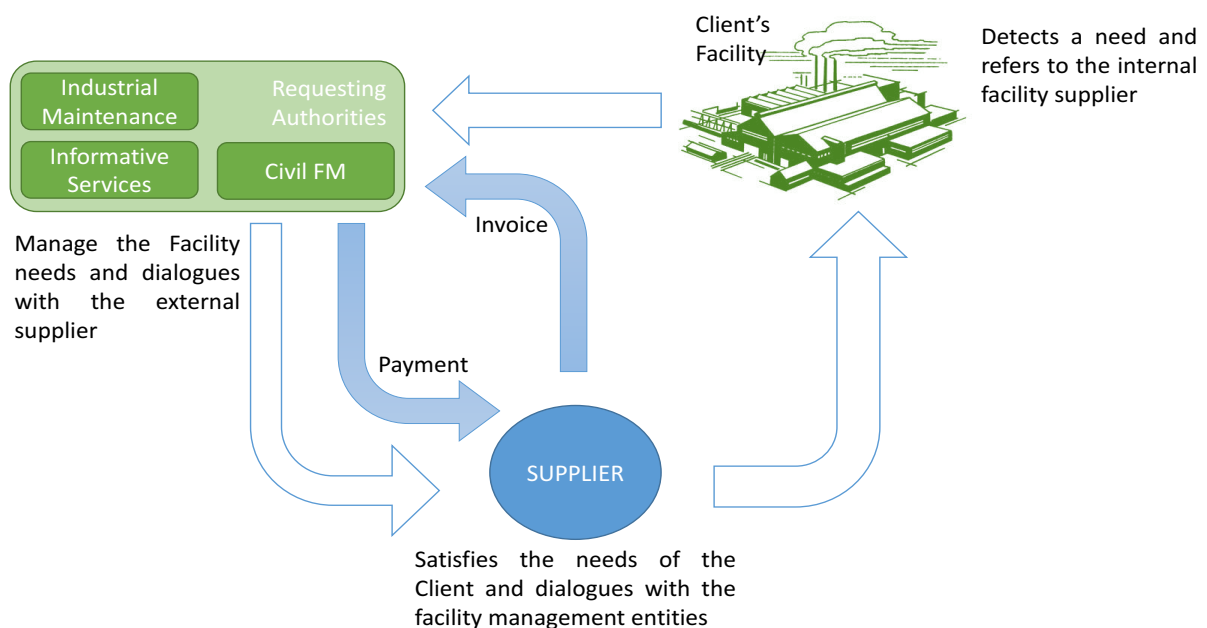


Fig. 9 - Scheme of the relation between the parties (source: J. Carrara)

#### IV. Criticalities

According to EN 15221/2006 the definitions of the responsibilities within the internal figures and for the external figures in a FM agreement is essential for an efficient execution of facility management activities<sup>19</sup> and all the stakeholders must be aware of the agreements taken<sup>20</sup>.

The described structure of the Client often leads to competence interferences that create problems in the correct execution of the works since there is not a unique figure/structure that judge the situations. The entities lack collaboration between them and relate with the Supplier independently, leading to a multitude of behaviors and procedures that the Supplier himself must manage.

To manage a building or an estate it is mandatory to have the knowledge of the architectural, property and performance characteristics that concern the elements itself. In the case study that has been analysed there is a general lack of information regarding technical aspects (systems, structures, construction methods adopted) by the involved figures and a lack of a precise definition of the methods with which the tactical figures must run their tasks. This generally leads to non-efficient procedures operated on a tactical and operational level.

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19 EN 15221–2:2006; 6.4.5. ALLOCATION OF MANAGEMENT RESPONSIBILITIES – “THE MANAGEMENT RESPONSIBILITIES OF STAKEHOLDERS, AFFECTED BY THE FACILITY MANAGEMENT AGREEMENT, SHOULD BE CLEARLY DEFINED; WHERE THE FACILITY MANAGEMENT SERVICE PROVIDER PERSONNEL ARE ACTING ON BEHALF OF THE CLIENT, THE LEVEL OF AUTONOMY AND OPERATIONAL SCOPE (POLICY, STANDARDS, CONFORMANCE AND ESCALATION PATH) SHOULD BE CLEARLY DEFINED AND THE LEGAL IMPLICATIONS FULLY CONSIDERED”

20 EN 15221–2:2006; 6.4.7 COMMUNICATION – “THE TWO PARTIES SHOULD ENSURE THAT ALL STAKEHOLDERS AFFECTED BY THE FACILITY MANAGEMENT AGREEMENT ARE INFORMED OF THE FINAL AGREEMENT AS WELL AS ANY SUBSEQUENT AGREEMENT MODIFICATIONS”.

## V. Possible improvements

In the light of this situation a possible solution to the issues generated by the different internal stakeholders of the contract, would be the structuring a unique body that comprehends representatives of all the internal stakeholders of the Client along with the Supplier’s strategical and operative figures.

This body, that can be considered a command center according to the description in the previous paragraph, will have decisional power over the contract activity and figures and will supervise the performance of the contract on a strategical level generating and adapting the procedures that manage the relationship between the parts.

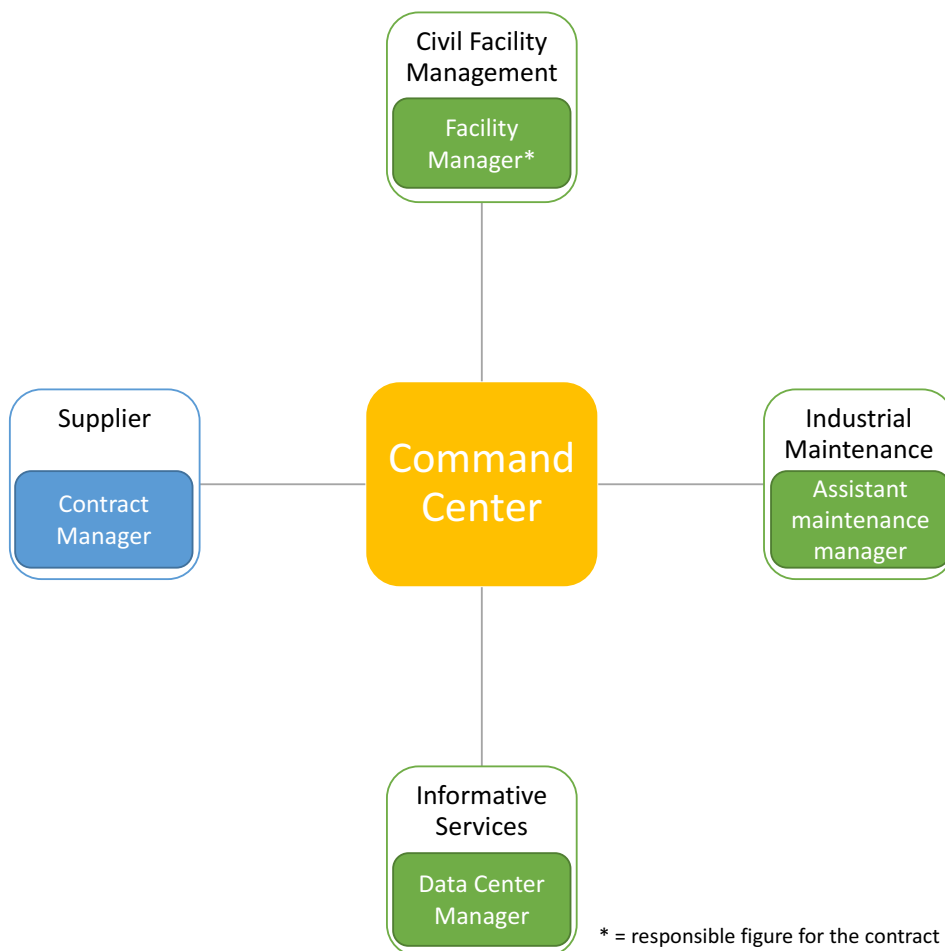


Fig. 10 - Proposed command center (source: J. Carrara)

The proposed structure of the command center for the contract is showed in the graph above; all the figures involved should have strategical decision-making authority to perform their functions within the command center without issues of competence. The Supplier is represented by the Contract Manager which brings to the command center all the problems that regard the operative execution of the interventions, the delays caused from the procedures and possible problems of interference; the Client is represented by the

corresponding strategic figures of the requesting authorities, where the Facility Manager is considered the figure that carries out the tasks of the chairman of the body.

This structure of a command center, managed jointly by the supplier and the client, could fit in the fourth model proposed by Talamo and Bonanomi (2015) [Fig.11] with some components of the open facility management structure proposed by De Toni, Ferri and Montagner<sup>21</sup> that opens to a collaborative strategical management of a FM contract.

The aim of this body is to define the general procedures of intervention that are binding for both Client and Suppliers, define the monitoring policy and methods, solve competence issues and take strategical decisions regarding the maintenance activities that are object of the contract. To efficiently allow the body to perform it should be scheduled to reunite the body on a regular basis, for example every two weeks.

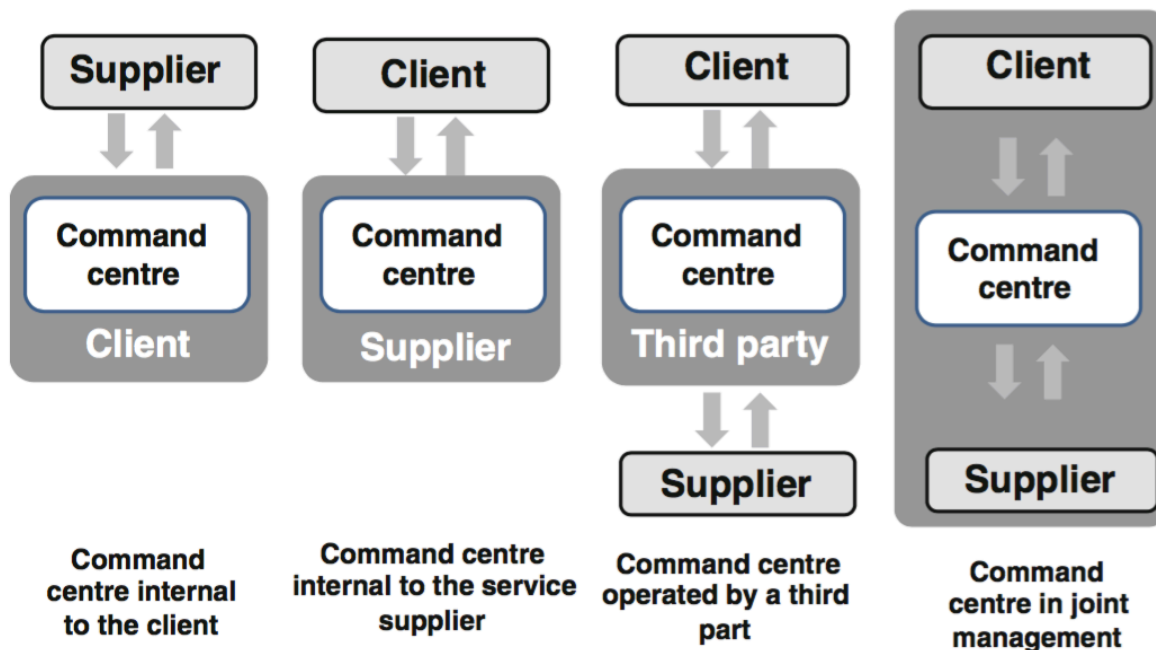


Fig. 11 – The main models for a command center according to Talamo and Bonanomi<sup>22</sup>

21 DE TONI A, FERRI A, MONTAGNER M – OPEN FACILITY MANAGEMENT – MILANO, IFMA, 2009.

22 TALAMO C., BONANOMI M. – KNOWLEDGE MANAGEMENT AND INFORMATION TOOLS FOR BUILDING MAINTENANCE AND FACILITY MANAGEMENT – MILAN, SPRINGER, 2015; CHAP. 5.3



## 2. Procedures

The following procedures are described in the tender contract and define modalities with which Client and Supplier should relate to execute their activities correctly. The contractual procedures are often considered delaying and annoying by the parties of the contract and the tendency to avoid and personalize the processes to the daily need is a common practice. Through these defined steps, it is possible to monitor the information flow of the contract and standardize the decision-making process and competent authorities; if correctly followed, the procedures can be improved easily, because a correct user as the sufficient knowledge to improve them, and increase the relationship between the Client and Supplier and with that the economic performance of the contract, a correct use leads to less disputes, less delays and easily solvable problems.

### 1. On-Fee activities

#### I. Preventive Maintenance – the Maintenance Plan

Based on EN 13306/2015, preventive maintenance is carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item<sup>23</sup>; while predetermined maintenance is preventive maintenance carried out in accordance with established intervals of time or number of units of use but without previous condition investigation<sup>24</sup>.

This activity is carried out through a defined Maintenance Plan. The Maintenance Plan (MP) is structured and documented set of tasks that include the activities, procedures, resources and the time scale required to carry out maintenance<sup>25</sup>; the MP is a critical requirement for the preventive and predetermined maintenance activities that must be correctly structured and handled by the Client and Supplier for an effective organization of the integrated services for the technical maintenance of the real estate. For its execution, the MP, requires supporting strategical/operational tools and informative tools that should be defined in the tender, a better definition of the tools leads to more efficient maintenance activity.

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23 EN 13306 CHAP. 7.1 – MAINTENANCE TYPES, PREVENTIVE MAINTENANCE

24 EN 13306 CHAP. 7.2 – MAINTENANCE TYPES, PREDETERMINED MAINTENANCE

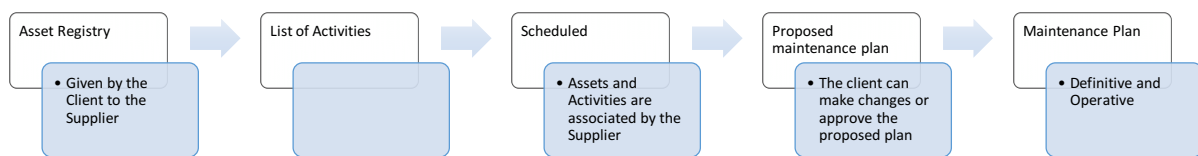
25 EN 13306 CHAP. 2.5 – MAINTENANCE PLAN

The plan is document that is written by the Supplier on annual basis, and annually reviewed, that represents the projected, planned and economical evaluated activities that the Supplier carries through the year and are included in the monthly fee that the Client pays the Supplier. The MP must be approved by the Client in order to be effective and, once approved, is binding for the Supplier.

The activities of the MP are shared by the Supplier with the Client, that may monitor the work process and quality of the executed works.

### *The drafting process of the Maintenance Plan*

The procedure to draft the MP is the described in the following chart:



*Tab. 3 - Drafting process of the maintenance plan (source: J. Carrara)*

- The Client gives the Supplier a list of assets that must be maintained and the respective locations, this list is called Asset Registry
- The Supplier, on the basis of its knowledge and the Asset Registry, creates a list of activities that are needed to maintain the various assets
- Every asset is then associated to a specific number and type of activity and everything is scheduled on the annual calendar. This creates a proposed maintenance plan that is submitted to the judgment of the Client
- The Client can modify the maintenance plan according to its need and the Supplier than resembles the activities till it is fully approved
- When the maintenance plan is approved then the Supplier can start applying it to the assets that are on the registry

*Criticalities*

The competence on the assets that are maintained through the MP is of all the three requesting authorities but is monitored only by the Civil FM authority, that executes audits on the MP activities.

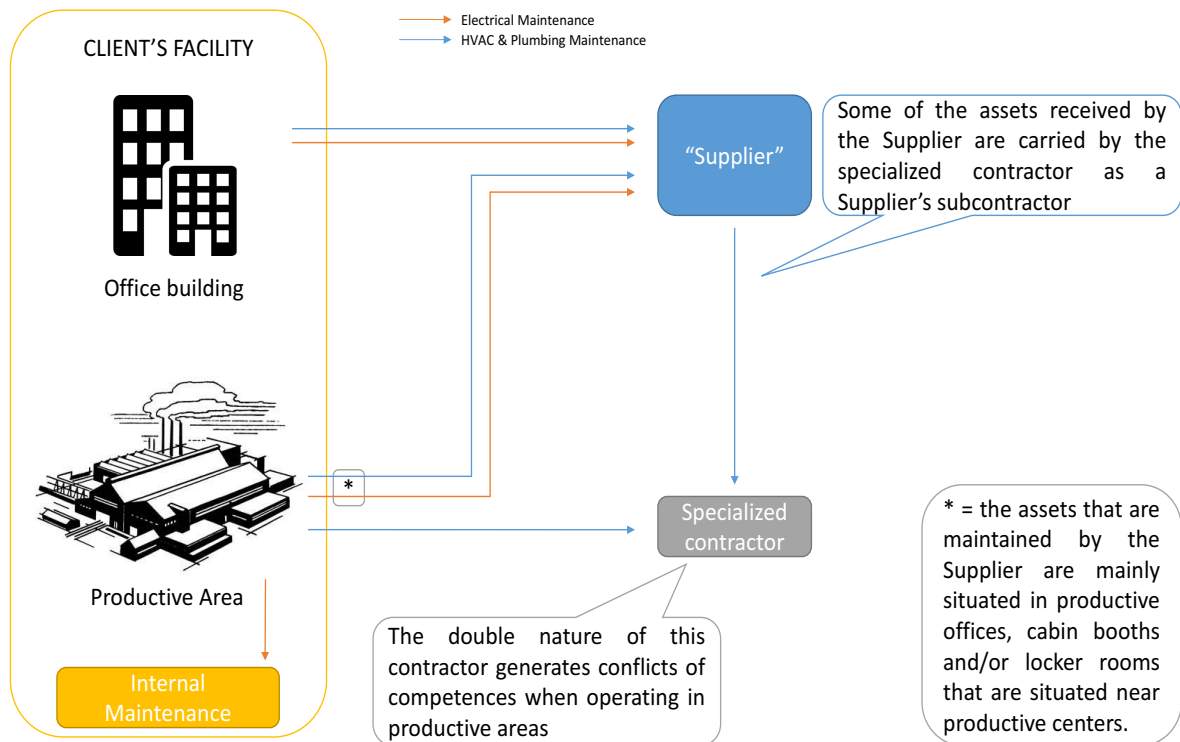


Fig. 12 - Competence interference on asset maintenance and double nature of firms as direct and indirect contractors (source: J. Carrara)

For the HVAC maintenance plan, the industrial maintenance authority divides the assets to maintain between the Supplier another specialized external contractor [Fig.12]. The division is made on the location of the asset in the productive center: productive offices, labs, major cabin booths and locker rooms are handed to the Supplier; all the rest is directly managed by the specialized contractor.

Due to the experience and knowledge in the area, the Supplier to hands the assets that is given to the same external contractor; the Supplier eliminates all those issues that could raise from operating the MP in a productive area (permits, documents, specific safety measures) but, on the other side, generates some competence conflicts between the two external suppliers, in case of fault intervention, and between the requesting authorities, in case of issuing a work order and audit in the productive areas.

*Possible improvements*

On supplier side, during all my stay, a solution to the problem was not found; the technician solved the issue basing on their own experience and on the dialogue between the two external suppliers.

To effectively solve the issue a sorting of the assets involved in the area should be carried on by the competent suppliers and the Client; this sorting has aim to a definition of internal competences between the authorities that manage the systems and then a definition of the supplier which carries out the maintenance on the system.

After a sufficient sorting is made the Client must define regulations on the relationships between internal Suppliers that clearly define the cases of interference and/or collaboration.

## II. Corrective Maintenance

According to EN 13306/2016, Corrective maintenance is the maintenance, carried out because of faults or failure, that aims to restore an element or system in a state in which it can perform the required function<sup>26</sup>, the activity can be executed immediately after the fault is detected or delayed according to the Client-Supplier agreement<sup>27</sup>.

For this tender Corrective Maintenance are intended all those maintenance works, that are executed on the systems that are written in the tender, that aim to restore functionality, and/or keep the prescribed standard level of service, without a radical and/or total substitution of technical elements. This maintenance is performed on all building systems that are situated in locations of competence of the Supplier; the cost of the intervention, of both labor and material, on all electrical, plumbing and HVAC systems is to be considered completely covered by the monthly fee.

Every other system that requires an activity that could be considered corrective maintenance should be managed by the Supplier and by the Client as an extra-fee activity.

Based on the urgency level, that defines the priority level, the fault repair works must be carried out within a time limit that has been decided together by the Client and Supplier. A repair work, once started, cannot be paused until the functionality of the faulted system is restored, even due to a temporary solution.

Only for the works that affect the safety of the work environment, whether the intervention does not allow the restoration of the full functionality of the system the Supplier must follow the following procedure to complete the work:

- Phase 1 – Buffer intervention  
Immediately after the notice of the fault the Supplier reacts by securing the system, the area of the fault and to obtain restore the functionality at the maximums possible level.
- Phase 2 – Completion  
This phase must be started as soon as possible and completed to restore the functionality of the system, as it was before the fault as occurred.

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26 EN 13306:2015; 7.7. CORRECTIVE MAINTENANCE – “MAINTENANCE CARRIED OUT AFTER FAULT RECOGNITION AND INTENDED TO PUT AN ITEM INTO A STATE IN WHICH IT CAN PERFORM A REQUIRED FUNCTION”.

27 EN 13306:2015; 7.8 DEFERRED CORRECTIVE MAINTENANCE – “CORRECTIVE MAINTENANCE WHICH IS NOT IMMEDIATELY CARRIED OUT AFTER A FAULT DETECTION BUT IS DELAYED IN ACCORDANCE WITH GIVEN RULES”.

**FAULT CLASSIFICATION**

<b>Urgency</b>	<b>Description</b>	<b>Reaction</b>	<b>Restore functionality</b>
<b>High</b>	Faults that: <ul style="list-style-type: none"> <li>– Causes or could cause interrupt the production of the plant (hours 9.00 to 18.00)</li> <li>– Causes or could cause interruption of the supply of critical services (ex. Data Center; water supply; etc.)</li> <li>– Causes or could cause the interruption of normal activities in critical periods (ex. accounting closing period; tender process closing; etc.)</li> <li>– Affect the safety level of the people using the structure (in ex. broken glass; electrical grounding faults; risk of slipping due to water leakage; etc.)</li> </ul>	Immediately after the notice of the fault	Within 1 days from the site inspection for at least 95% of the faults. The remaining 5%, referable to faults of significant nature, must be carried out within 5 days from the site inspection.
<b>Medium</b>	Faults that: <ul style="list-style-type: none"> <li>– Partially compromise the safety of the building (in ex. fault at some terminal of the anti-intrusion system; fault detected on the antifire system; etc.)</li> <li>– Affect seriously, for the work activities, the internal parameters of the offices/rooms (temperature, illumination, sound level)</li> </ul>	Within 1 day from notice	Within 5 days from the site inspection for at least 95% of the faults. The remaining 5%, referable to faults of significant nature, must be carried out within 10 days from the site inspection.
<b>Low</b>	All other faults	Within 5 days from notice	Within 10 days from the site inspection for at least 95% of the faults. The remaining 5%, referable to faults of significant nature, must be carried out within 20 days from the site inspection.

Tab. 4 - Fault classification and prompt intervention guidelines (source: tender)

### III. Procedure for fault repair work

The Client has several selected Authorities that can issue a work order to the Supplier; these different Authorities have different areas of competence that, generally, do not overlap. In case of a conflict of competences there is no specific guideline to follow, the Client must solve the conflict and proceed to make the Supplier a precise request.

The Authorities that are entitled to make and manage the work orders are:

1. The Civil Facility Management Office (Civil FM)

This entity dialogues with all the other non productive entities of the Client's structure and transmits the needs to the Supplier. The Civil FM is responsible of the management of the information flow from the Supplier to the Client and manages the accounting data that flows from the Supplier to the Client, if these are not directly managed by the other 2 requesting entities. The Supplier is the only supplier for the services that are specified in the tender.

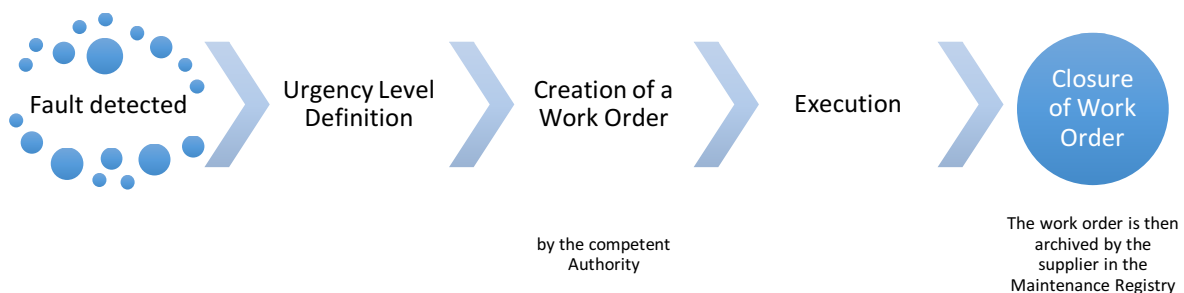
2. The Industrial Maintenance

The Supplier is not the only supplier for the services linked in the tender; the entity has several suppliers that operate in the production facility (internal and external) that may or may not provide similar services to the entity.

3. The Informative Services

This entity has a full time operator that provides the services required by the contract. The work orders that come from this entity are managed separately, directly by the designed operator with the Contract Manager that is kept on notice.

The following procedure [Tab. 5] is reported in the Tender both directly and indirectly, it describes the necessary steps that the Supplier must follow to correctly execute a repair work once the fault is detected.



Tab. 5 - Procedure for the execution of an on-fee intervention (source: J. Carrara)

1. The fault is detected, by either the Client or the Supplier, and the adequate authority that is affected by the situation is informed by the detector.
2. The Authority evaluates the situation and defines the urgency level according to its knowledge of the activities that are affected by the fault
3. The Authority issues the work order to a supplier through the IT platform that must contain the following information:
  - serial request number (every work order must be unique to be traceable)
  - identification of the Supplier
  - identification of the requesting Client's entity (username, cost center)
  - location (plant, building, floor, room)
  - typology of the request (carpenter, blacksmith, electrician, plumber, etc.)
  - object of the request (a brief description of the fault and the urgency level defined)
4. After the execution of the Supplier starts the procedure for the closure of the work order by returning to the Client the following information:
  - serial request number
  - typology of the request
  - starting and finishing date of the intervention
  - brief description of the executed work
5. All the work requests that are executed and closed are kept by the Supplier in a Maintenance Registry that is managed through an IT platform.



## 2. Extra-Fee activities

Extra-fee activities are extraordinary activities that are provided on request by the Supplier. The request must be managed through work orders in a process that is comparable to the one seen for the fault repair work. All the activities are managed within the Informative System of the Client and on the Client's IT management platform.

### I. Extraordinary Maintenance

These interventions can be all considered corrective maintenance<sup>28</sup> or deferred corrective maintenance activities<sup>29</sup> that have a critical impact on the systems or structure that requires the intervention.

In the analysed tender, they are defined as non-recurring interventions that aim at the maintenance and substitution of important components of a system (in ex. replacement of a refrigeration unit, new roof insulation, etc.) without modifying the characteristics and functionality of the system/structure. Due to the economic importance of these works they are excluded from the services included in the monthly fee.

As the work order is issued the Supplier must elaborate a Cost Estimate of the intervention and issue it to the Client's competent authority for a cost analysis. The Supplier should wait that the Cost Estimate is approved by the competent authority to start the works. The aforementioned authority is not forced to give the work to the Supplier but can also outsource to an external company; in this case, the Supplier is intended to supervise the works and supply assistance to the third company.

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28 EN 13306:2015; 7.7. CORRECTIVE MAINTENANCE – “MAINTENANCE CARRIED OUT AFTER FAULT RECOGNITION AND INTENDED TO PUT AN ITEM INTO A STATE IN WHICH IT CAN PERFORM A REQUIRED FUNCTION”

29 EN 13306:2015; 7.8 DEFERRED CORRECTIVE MAINTENANCE – “CORRECTIVE MAINTENANCE WHICH IS NOT IMMEDIATELY CARRIED OUT AFTER A FAULT DETECTION BUT IS DELAYED IN ACCORDANCE WITH GIVEN RULES” .

## II. Ameliorative Maintenance

The works that provide a substantial improvement to the efficiency of the systems and to management cost reduction are included in the annual Client's budget for investments; these activities are not strictly considered "maintenance", according to the technical EN norms, since they do not restore a functionality but rather increase it modifying the design of good; but is considered a Supplier's activity by the Global Service contract guidelines proposed by UNI 10685 that specifies the duty of the Supplier itself to propose works that are considered necessary that will analysed and eventually approved by the Client.

Ameliorative maintenance can be considered the group of activities, that the Supplier provides to the Client, aimed to introduce improvements to an asset (or part of it) within the limit of the restoration of the original functionality. It can be considered a form of maintenance activity that is executed on assets that are affected by obsolescence, restoring their essence to their original level, or the highest possible and updating their characteristics to the level requested by the regulations<sup>30</sup>.

Since the plant was built in 1910, despite several restoration interventions, many parts of the facility are out of date and systems are obsolescent. Mainly in the various office buildings that have an historical and representative value for the company, dated approximately within the 60's and 70's, restorations interventions have been delayed and did not completely solve critical issues with the structure and the systems of the buildings.

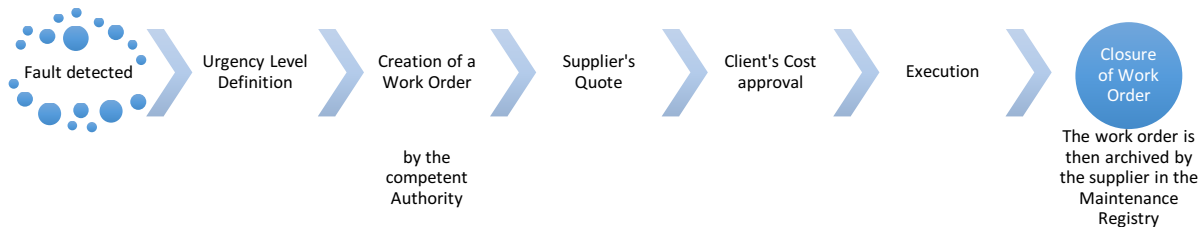
With the economic reduction of the contract the budget for these types of interventions has been drastically reduced by the Client; therefore, many activities that can be considered ameliorative maintenance must be authorized directly by the Client's governance managers, not only by the Facility Manager. This situation has frozen al interventions of ameliorative maintenance and the Supplier rarely proposes new improvement to the Client's authority since they are already in knowledge of the criticalities of their facility after several notifications.

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30 MOLINARI C. – PROCEDIMENTI E METODI DELLA MANUTENZIONE EDILIZIA, VOL.1: LA MANUTENZIONE COME REQUISITO DI PROGETTO; NAPOLI – SISTEMI EDITORIALI, 2002. CHAP.4 P.135

### III. Procedure for Extra-fee activities

The procedure for all extra-fee activities is like the one used for fault repair work orders, the main difference is linked to the Cost management of the intervention that is absent in on-fee activities.



Tab. 6 - Extra-fee intervention procedure (source: J. Carrara)

1. The fault is detected, by either the Client or the Supplier, and the adequate authority that is affected by the situation is informed by the detector.
2. The Authority evaluates the situation and defines the urgency level according to its knowledge of the activities that are affected by the fault
3. The Authority issues the work order to a supplier through the IT platform that must contain the following information:
  - serial request number (every work order must be unique to be correctly traced in the informative system)
  - identification of the Supplier (there must be a clear definition of the Supplier for which the work order is issued to eliminate competence)
  - identification of the requesting Client's entity (requesting user and internal cost center)
  - location (is intended the area where the fault is perceived or the actual area of the fault. The authority can indicate plant, building, floor, room; if the location is not clearly defined there must be a sufficient indication in the brief description that specify the area or locations affected by the fault)
  - typology of the request (carpenter, blacksmith, electrician, plumber, etc. in case the intervention is supposed to require multiple specializations, the work order must indicate the required typologies supposed by the requesting authority)
  - object of the request (a brief description of the fault and the urgency level defined, the description must be clear and understandable by the office staff and technicians)

4. Once the Supplier receives the work order he gives the Client a quote of the intervention, if needed, before he starts the intervention.
  - a. If the responsible authority defines the highest level of urgency, meaning that the fault affects the safety measures of the labor environment, the Supplier is authorized to immediately execute a buffer intervention to restore the appropriate safety level.
5. After an evaluation is made by the Operative Control Manager, the budget must be approved by the Client and the execution of the work depends on this approval in any case, except when the fault affects safety as written above, where the buffer intervention can be made prior the approval of the Client. Every further intervention must undergo a costing procedure and traced in the Maintenance Registry. The cost estimate has to be linked to the work request and must contain sufficient information to be connected to it.
6. After the execution of the Supplier starts the procedure for the closure of the work order by returning to the Client the following information:
  - serial request number
  - typology of the request
  - starting and finishing date of the intervention
  - brief description of the executed work
  - reference to the cost estimate
  - balance of the material and committed hours of the intervening technicians
7. All the work requests that are executed and closed are kept by the Supplier in a Maintenance Registry that is managed through an IT platform.

### 3. Monitoring

The activities executed by the Supplier are monitored monthly by the Client with audits run by the operation control managers on MP activities and cleaning services or by KPI indicators on all the activities made on request.

#### 1. Monitoring planned activities – Audits

The audits for cleaning and for MP are basically structured in the same way, I now highlight a typical MP audit to explain the procedure, this methodology can be applied to the cleaning services audits.

Within the month, the Client informs the Supplier of the audit with short notice, selects the locations of the facility where the audit will be taken and declares the MP activities that will be analysed in the audit. The auditing activity then consists in two separate phases, all of them with the presence of two Client's tactical members and the Supplier's contract manager; the first phase is an on-site verification of the execution of the maintenance program activities, state of the art and quality of the maintenance intervention. The Client defines some locations in the facility to verify and runs the verification along with the contract manager that is responsible for the done work of the operational team; the contract manager is present so that he may explain criticalities involved in the execution of the activities, motivate interventions and delays on the maintenance plan. At the end of the first part of the audit the Client gives some marks to what he has seen (1, lowest, 3 or 5, highest) on an audit report.

The second part of the auditing process is made in office where Client and Supplier verify all the maintenance program's work orders, their execution, correct drafting of the work report and the correct archive organization made by the Client. Even for all these passages the Client report on a sheet the marks for what he has analysed.

When reporting the marks on the audit report the Client and the Supplier debate on the marks that are going to be assigned. The marks are set on specific KPI that have been defined together by Client and Supplier and they are weighted and processed, with the knowledge of the Supplier, to generate a final average mark for the single audit.

*Penalties & bonuses*

The average monthly mark for the audits are used to define if penalty that should be applied on the monthly fee perceived by the Supplier, penalties consist in the deduction of a defined percentage of the total maintenance monthly fee when the average mark is below the mark required by the SLA.

The penalties can reduce the amount of the interested fee up to 6% of the total value.

The SLA set the required average mark “x” of the monthly audits to be 4 for each service examined; therefore, the penalties are structured as:

<i>Average audit mark</i>	<i>% of fee paid</i>
$4 < x < 5$	100%
$3,5 < x < 4$	99%
$3 < x < 3,5$	98%
$2 < x < 3$	96%
$1 < x < 2$	94%

*Tab. 7 - Penalties applied on the monthly fee (source: tender)*

## II. Monitoring on-request activities – KPIs

The Client and the Supplier set some KPIs to monitor the on-request activities and evaluate the Supplier's performance. These KPI are intended to provide information to the Client on the Supplier's workshop activity but are not linked to specific SLA or penalties on the economic compensation.

The information involved in the calculation of the KPI's are time data gathered on the informative system of the Client and used by the Client itself to produce monthly or trimonthly report to discuss the performance of the contracting activities with the Supplier.

On request of intervention, once issued by the Client, it should be possible to identify the following information:

ACCEPTANCE DATE – date in which the Client gives notice to the Supplier of the intervention;

EXPECTED START – date in which the Supplier supposes to start the activity;

EXPECTED FINISH – date in which the Supplier supposes to finish the activity;

START DATE (or real start date) – the actual starting date of the intervention;

FINISH DATE (or real finish date) – the actual finishing date of the intervention;

With these data, the Client can generate the following KPI's:

LEAD TIME – Difference between START DATE and ACCEPTANCE DATE;

PROMISE – Difference between the intervention's expected start and expected finish;

DURATION – Difference between the real start date and real finish date;

DELAY – Difference DURATION and PROMISE;

INITIAL COMPLIANCE – Difference between an intervention's real and expected starting date;

FINAL COMPLIANCE – Difference between an intervention's real and expected ending date;

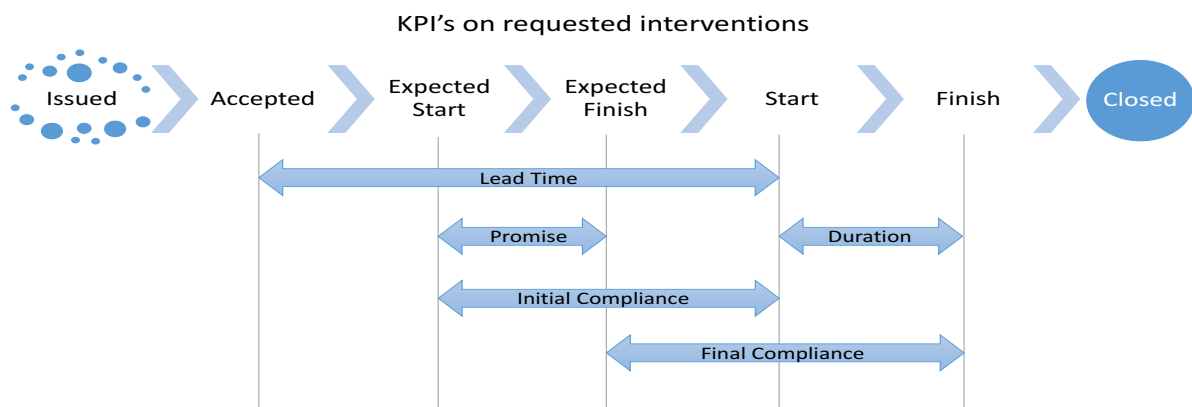


Fig. 13 - KPI illustration on a work order's lifetime

### Penalties & bonuses

On the on-request activities no penalties or bonuses are defined by the tender

#### 4. Adapted procedures

For the dimensions of the facility and complexity and variety of the possible works requested the procedures that manage the relationship and the flow of information between the Supplier and the Client have been modified and personalized for each situation, entity or urgency level. Being inside the Supplier's structure as an assistant has given me the ability to understand and define the used procedures and the critical aspects of them.

An important premise to say is that theoretically all the information that flows between the Client and the Supplier should remain within the Client's informative system. This premise is not always respected since many requests and agreements are made on a verbal level without a clear trace of the information flow. The works that are issued by a verbal request are always supported, prior or after the execution, of a written confirmation from the Client that is considered as an authorization to intervention.

The Client structured an IT platform, for the management of the work orders that are issued between the two parts, that it's supposed to be used by all its requesting authorities. As a matter of fact, only the Civil FM manages its works through the platform; the other entities, due to the competences that they cover, continue to relate with the Supplier via e-mail.

All the interventions are physically kept on paper in an archive that is held by the supplier in its office, this archive is divided by entity but the interventions are not all catalogued in a traceable way.



## I. Procedure for intervention - Civil FM

The Civil FM brings to the Supplier's structure the clear majority of the work orders, in respect of the other two entities. The relationship with the Entity is supported by an IT platform that manages the requests of intervention and the accounting process between the two parties, this platform is managed by the tactical figures of the office structure of both the Client (Operative Control Manager) and Supplier (Site Manager).

Different procedures are used for different faults; depending on the accounting criterion, the typology of the research and who detects the fault.

### *On-fee requests*

These interventions, that respect to the fault repair work procedure that has been described in the appropriate paragraph in chapter 2.1, are characterized by the fact that the Client does not recognize any financial consideration on the done work.

In the following paragraphs, I will illustrate different situations and the different steps taken from the detection to the execution.

#### 1 Detection from the Supplier

In the case that a fault is detected by the Supplier during his daily routine, the work, in compliance with the safety measures, is immediately executed without giving notice to the Client.

If the operator is entitled to execute the intervention and the work doesn't require a purchase of material, he proceeds to evaluate the fault and repair it. After the execution, a work report is made and is given to the office staff that archives it.

If the operator is not entitled to execute the intervention, he notices the office staff of the fault and proceeds with the work; at the end of the work the detecting operator is invited to write a notice report of the fault to keep trace of the detection. As the notice is received, an appropriate operator is sent by the office staff to fix the fault, he executes and returns a work report of the execution for the office staff.

There are cases where there is a need for a purchase of materials to repair the fault. After the office staff takes the notice, a purchase of material is organized with the operators and the execution is planned within the following days. Since the purchase of material for on-fee activities is made by some Supplier's suppliers that are outside of the facility there is a necessity to organize the trip for the purchase.

All those faults detected by the cleaning service subcontractor are to consider as detected by the Supplier.

2 Detection from the Client

During the Client’s daily working activities, that are made within the competences of the Civil FM authority, a user may notice a fault, a decrease of the functionality in a system, a decrease of comfort in a specific work area. The user notices the Civil FM authority describing the fault or the decrease of comfort perceived.

If the intervention involves a substitution of an on-fee element, the authority issues a work order to the Supplier through the IT platform giving a time fence in which the work must be done. The Supplier plans the activity on the IT platform within the time fence so that the Client can have a feedback on the work order. Once a technician has executed the order without further notifications the Supplier closes the work order on the IT platform, declaring the finishing of the works. An example of this kind of intervention is a blown bulb or a clogged sink.

If the intervention is considered part of the conduction of the systems, the Client does not issue a work order to the Supplier but instead asks him to verify the issue and restore the functionality of system. An example of this kind of intervention is a temperature set on an office fan coil unit or a lack of current due to a skipped switch in a buildings distribution board.

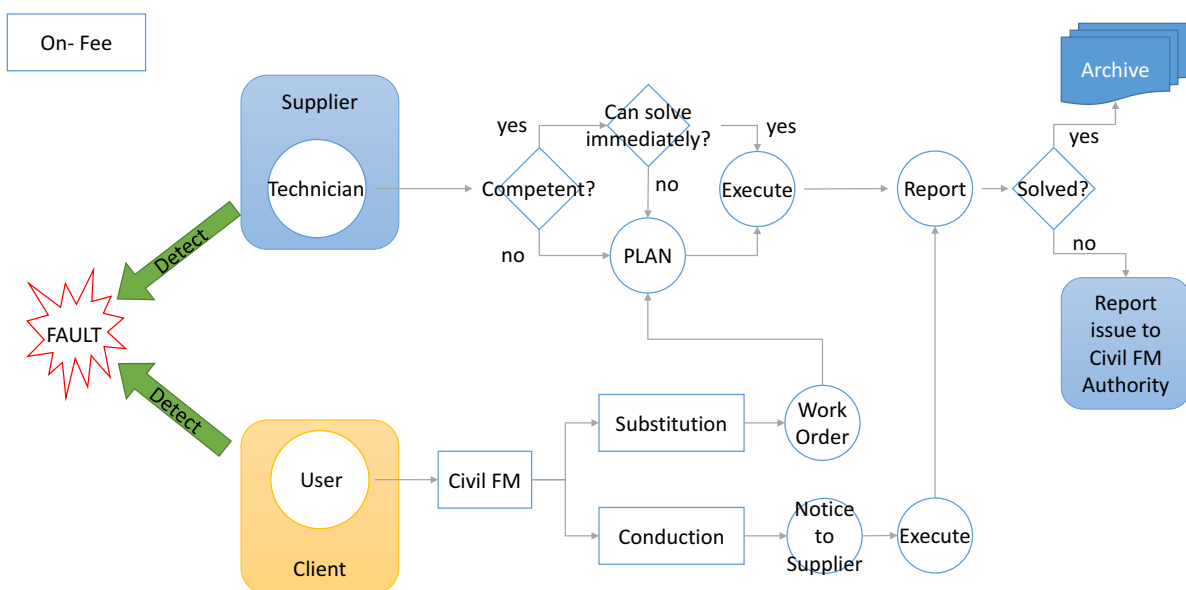


Fig. 14 - Civil FM's intervention procedure for on-fee activities (source: J. Carrara)

### *Extra-fee requests*

If the execution of one of on-fee activity evolves in an extra-fee activity, the Supplier restores safety and functionality (as possible) and interrupts the activities for the work order. These interventions, that respect the procedure described appropriate paragraph in the 2.2 chapter, are interventions that are not included in the monthly fee and their execution is subject to the Client's approval to proceed. The Client, in the form of the generic user is not entitled to request an intervention that involves a payment towards the Supplier outside the monthly fee. Every intervention that requires a substitution of a critical element of a maintained system, or, generally, every intervention that requires a purchase from the Supplier, of both workforce or materials, must be approved by the Civil FM authority. In the following I describe the different situations in which an extra-fee work order is issued.

#### 1. Detection by the Supplier

The Supplier may detect a fault, that generates an extra-fee activity, during the execution of a work order by one of its technicians. The technician immediately notices the site manager of the fault and evaluates the risks associated, if the risk affects the safety level of the system the Supplier can immediately intervene to restore the required safety, if the risk does not affect the safety level of the system the Supplier does not intervene. The Supplier gives notice of the fault to the Client and proposes a solution or possible alternative solutions. The Client analyses the possibilities and issues a work order specifying which intervention has to be made in order to repair the fault.

#### 2. Issuance from the Client's Requesting Authority

The Civil FM authority may issue directly an extra-fee work order without the need of a site inspection or an on-fee work order. As a particular fault or need is detected, the Authority evaluates the type of intervention required; basing the decision on the knowledge, they can create an order directly for a substitution of a critical element of the system or for the purchase of a particular service from the client. As the order is issued to the Supplier, the Supplier is immediately authorized to intervene to solve the issue.

## II. Procedure for intervention – Industrial Maintenance

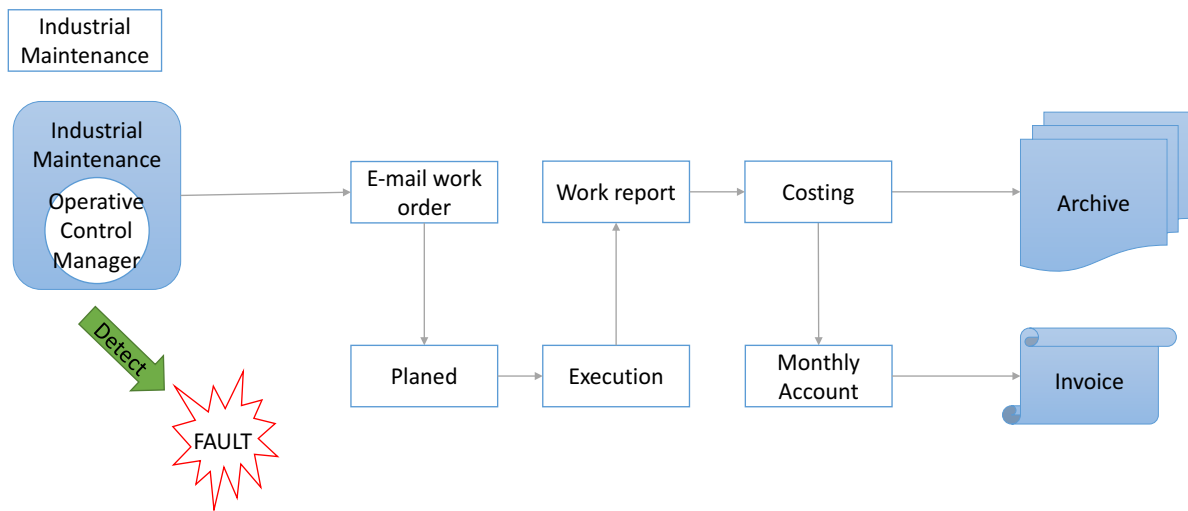


Fig. 15 - Industrial maintenance's intervention procedure (source: J. Carrara)

The Industrial Maintenance is the authority that should maintain all the elements that provide the correct functionality in the production flows. This entity requires mainly extra-fee activities from the Supplier since the it has very little assets that are competence of the Tender I am analyzing.

This entity has a responsible figure that can be considered an Operative Control Manager that relates with the Supplier's governance for the activities that are required; this figure issues work orders and manages the accounting process between the entity and the Supplier. The process for the execution of the work orders is structured as follows:

1. The entity detects the issue, analyses the needs and/or problems related and defines the activities required to solve the issue
2. If the required activities comply with the contract activities provided by the Supplier, the entity gives notice to the latter via e-mail of the requested works
3. The office staff plans the intervention
4. The technician executes the requested works and generates a report of the intervention for the office staff
5. The Supplier gives notice to the entity of the resolution or any problems encountered
6. The office staff does a cost analysis of the done work and delivers the reports of the interventions & costs to the Contract Manager
7. The Contract Manager issues a monthly invoice towards the Client

The procedure that is used for this entity is way simpler compared to the one seen with the Civil FM entity. This procedure allows the Client to rapidly solve problems and the Supplier to execute the work with less bureaucracy, on the other side does not keep trace of the done works for either parts. There is poor cost control on the Client side and less control of the efficiency and account payable on Supplier side; this situation leaves a considerable amount of work request without proper control on their status and increases the number of requests that are not correctly categorized or accounted, damaging both parties.

### III. Procedure for intervention – Informative Services

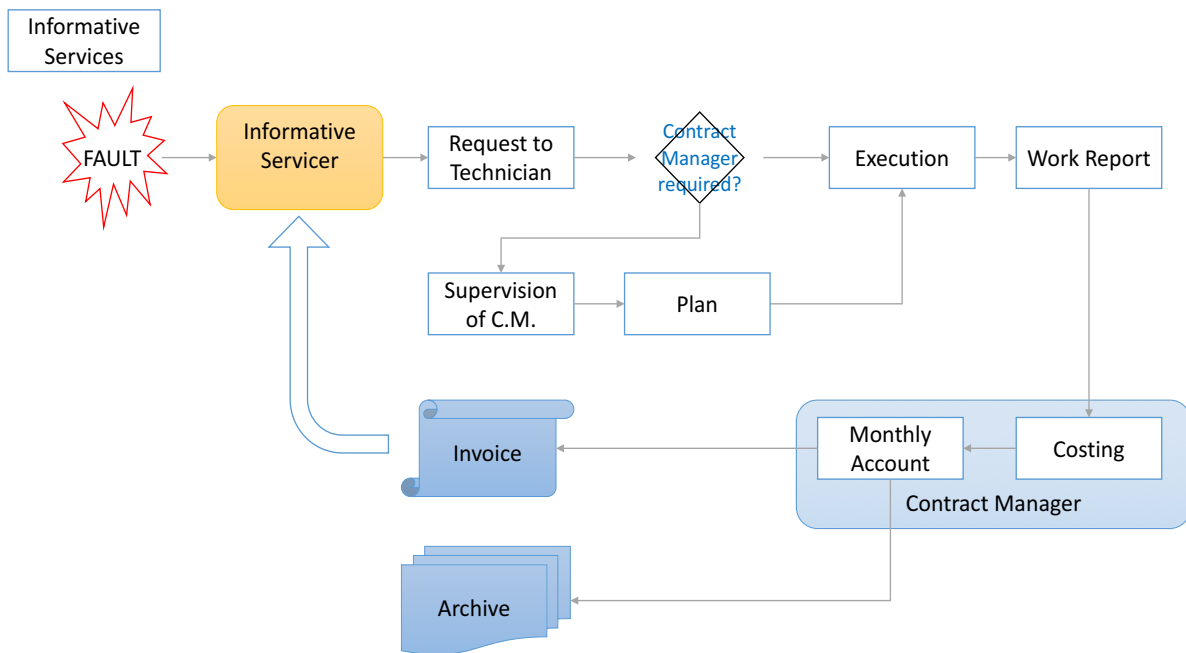


Fig. 16 - Informative service's intervention procedure (source: J. Carrara)

The Informative Services authority is the third and last entity that can issue requests towards the Supplier. This entity, who operates in the Client's IT sector and Data Center, has a particular relationship with the Supplier's structure due to its particular requirements and critical importance for the Client; to grant a rapid intervention and preserve the functionality, the Supplier structured a special service dedicating a technician who operates full time on the entity's requirements. This service comprehends a dedicated e-mail address, that is visible by both the technician and the Supplier's governance, that is used by the Informative Service entity to communicate with the Supplier, ask for requests and issue work orders.

Every request is managed through this e-mail address directly by the technician without the governance's supervision; the Client may require the Contract's manager intervention for critical works that require an extra-ordinary expenditure or the work of other technicians.

The intervention procedure can be structured as follows:

1. The Client's Informative Service entity detects an issue in its competence
2. A work order is issued directly to the technician for the intervention
3. The technician immediately takes charge of the intervention and, in accordance with his competences, executes the work or plans it for the following days.
  - a. Whether the work requires another specialist the technician and the entity require the supervision of the Contract Manager to execute the intervention

- b. Whether the issue requires a substantial expenditure of resources, the Client contacts the Contract Manager to arrange the required works before the execution
4. The technician writes a report of the done work and delivers it to the office staff of the Supplier;
5. The office staff analyses the report, operates a costing analysis on the done work and delivers the report to the Contract Manager;
6. The Contract Manager creates a monthly invoice towards the entity and archives the reports.

#### IV. Procedure for Maintenance Plan Activities

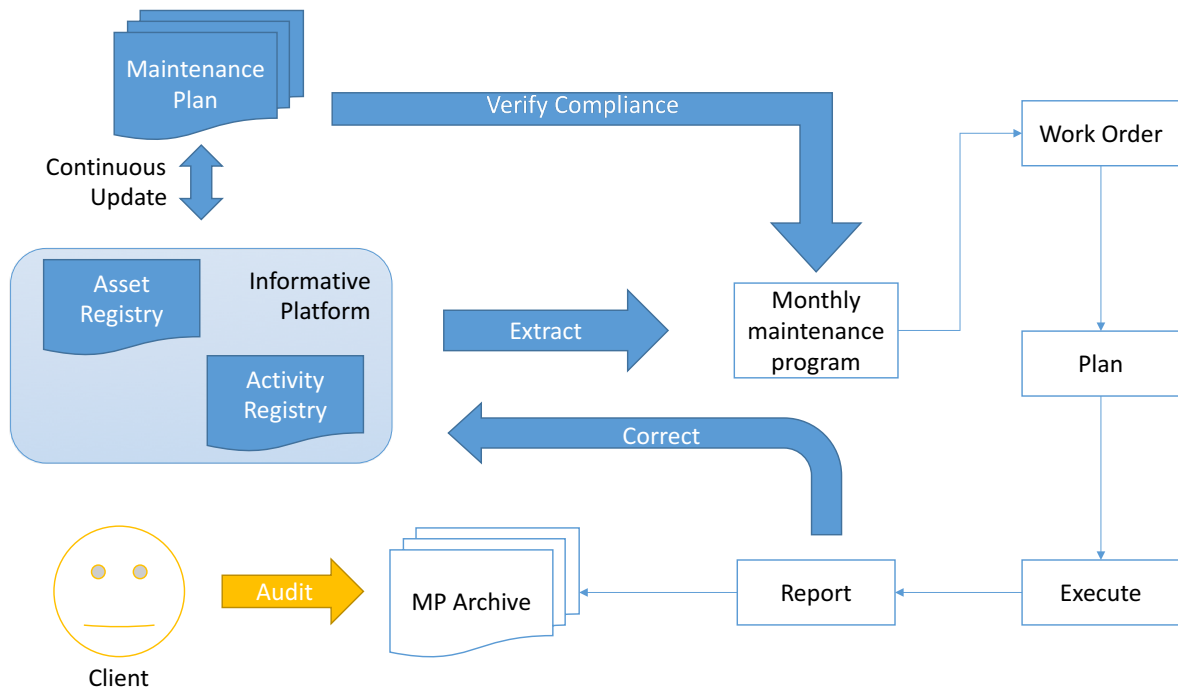


Fig. 17 - Maintenance plan's and maintenance program's activities procedures (source: J. Carrara)

The Maintenance Plan (MP) is a document that is drafted by the Supplier, issued to the Client for approval and then executed by the Supplier itself. The annual schedule of the MP is kept by both parties: The Client has an approved version of the MP in order to monitor the execution, the Supplier has the same version and an informatics tool for the issuing of the scheduled activity's work orders. The two versions that are in possession of the Supplier must always be matching and updated, for each update on the MP the Client is given notice to always have a unique MP schedule that is monitored.

Every month the Supplier controls the assets to be maintained and creates the requested work orders through its informative platform. The work orders that have been created represent the maintenance program<sup>31</sup> and are printed and scheduled throughout the month to execute them within the end of it; the activities do not have a specific date in which they must be executed,

31 TALAMO C. – PROCEDIMENTI E METODI DELLA MANUTENZIONE EDILIZIA, VOL.2; NAPOLI – SE-ESSELIBRI, 2010. CHAP. 12 P.162 – “THE MAINTENANCE PROGRAM SCHEDULES ON THE CALENDAR THE ACTIVITIES PROVIDED BY THE MAINTENANCE PLAN; THE PLAN DEFINES DEADLINES, RESOURCES, TECHNICAL-ORGANIZATIONAL MODALITIES, LOGISTICS AND COST ESTIMATE OF THE ACTIVITIES”.



but the maintenance program is entirely manageable by the Supplier that can execute it according to the other requests that are issued towards him.

The Supplier hands the work orders of the maintenance program to the technician for the execution and work report; the executed work orders are kept by the Supplier in folders, sorted by month and location to keep traceability of the MP activity throughout the contracting period. The Client monitors the MP with from two to four inspections every month that provide an evaluation of the works and influence the monthly fee that is paid to the Supplier. Beyond the quality of the work done with the MP work orders, a correct storage of the work order files is a required activity for the Supplier that is evaluated by the Client.

Every critical issue found by the Supplier in the execution of the MP has to be noticed on the work orders and given notice to the Client. These issues must be solved by the Supplier to restore the functionality of the systems, the works that derive from the MP are not necessarily on-fee requests.

## 5. Criticalities

The procedures adopted to manage the relationship between the parts in the contract lead to many uncomfortable situations for the Supplier and for the Client that generate inefficiency and some major loss of information.

### *General procedure criticalities*

The procedures described in the tender do not meet the effective requirements of the client's entities and generated the personalized procedures.

With the adoption of different procedures for different situations or Requesting Entity, many interventions are run outside the Client's informative system and the information is not correctly shared between Client-Supplier and even between the different internal clients.

With the activity reduction defined by the contract downsizing the Client agreed to remove the allowance that the Supplier should respect. This, apart from the economic issues that creates, generated a difficult evaluation of the activities that the Supplier is executing and, therefore, a difficult classification and control of on-fee or extra-fee activities.

### *Maintenance manual*

The information regarding the maintenance manual, for what concerns the creation of the maintenance program, are managed by an IT tool that is of private property of the Supplier and is not shared with the Client.

UNI 10874:2000 defines the maintenance manual as an organic and systematic information gathering that represents the basis of the knowledge from which to draw for the drafting of the MP. All the information gathered in the maintenance manual, according to UNI 10874:2000, are divided in three categories: identifying and descriptive information on the asset; guidance information on the specific activities required by the asset; feedback information on the executed activities.

### *Maintenance program*

The definition of the maintenance program is entirely competence of the Supplier and the Client is not able to verify the scheduled dates for the activities. The nature of the contract, Global Service agreement, generates conflicts regarding the sharing of information on organizational procedures; the Supplier, who's only duty is to ensure the execution of the activities according to a defined service level, does not consider mandatory the sharing of the

maintenance program since it is not influencing the Supplier's performance. Therefore, the Client is unable to have sufficient information on the activities on the maintenance program.

### *Monitoring*

The global service contract, as said before, is a facility management agreement based on the achievement of specific results by the Supplier. Therefore, the measurement of the performance should be made through qualitative standards and not only on time standards. UNI standards for Global service agreements defines two operative standards with which monitor the activity: quality standards, defined as the required quality levels of the performances that the Supplier should respect in every intervention, and service standards, defined as the characteristics and the frequencies of the maintenance activities required by the Client<sup>32</sup>. The as is situation describes a monitoring process for on-request intervention is based on parameters that do not correctly evaluate the quality performance of the Supplier: the KPIs on the interventions are measured are all based on the time.

Furthermore, the monitoring process is mainly focused on the control of the Supplier's performance but should also be considered an effective generator of feedback information for the Supplier to improve the quality of its activities. The generation of monthly reports (once mandatory for the Supplier, now dismissed) should be considered a very important communication and problem-detection instrument for both parties involved in the maintenance activities.

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32 TALAMO C. – PROCEDIMENTI E METODI DELLA MANUTENZIONE EDILIZIA, VOL.2: IL PIANO DI MANUTENZIONE (AMBITI DI APPLICAZIONE, STRATEGIE E PROCEDURE); NAPOLI – SE-ESSELIBRI, 2010. CHAP.6 P.83

## 6. Possible improvements

There are several issues that create discomfort in both sides and lead to a decrease of the performance in economic and technical terms; these issues are typically managed and solved a correctly structured command center, highlighting once again this need.

### *Define procedures*

A clear and well-structured definition of the procedures for the interventions, both on-fee and extra-fee, is a major improvement that should be considered by both the Supplier and the Client. After an investigation on the internal needs of the different Client's requesting entities, the procedures should take into consideration the mandatory traceability of the information, the ease with which an intervention request should be managed and the different work locations, therefore different safety requirements, that the Supplier must deal with.

To reduce competence interferences the procedure should take into consideration the sharing of the information within the requesting authorities; once an intervention is requested, the other authorities are aware of it.

The requesting and executing procedure should be based on a single structure for all the requesting authorities, so that they can dialogue with the Supplier in a unique way and the management activities, operated by the Client, is comparable. Further personalization of the procedures, that aim to efficiently match the needs of the Client, must be shared with requesting authorities and with the Supplier to highlight possible issues arising with the changes. These modifications shall remain compliant with the primary defined structure for the intervention request and intervention.

Since the Client provided the Supplier with an informative tool for the management of its activities the information flow should be managed exclusively through this tool by both parts. The definition of standards for the communication between the parts is highly recommended for a major diminishment of the delays that are generated by information misunderstanding.

### *Re-introduction of an allowance*

The definition of an allowance for the interventions is requested to monitor and increase the control on the on-fee and extra-fee activities. An allowance may be different for different work activities or different for type of assets; with a clear definition of the allowance value the Supplier is clearly aware of the on-fee activities and the Client can more effectively control the costs of the interventions.

### *The maintenance manual*

The creation of a shared, unique maintenance manual, as defined by the UNI norm<sup>33</sup>, between the Client and Supplier that is set on a shared informatics tool/system. The maintenance manual, that should be considered a mandatory document for the execution of the contract, must comprehend the information gathered by the Supplier and Client within the contracting period and should be constantly updated with the consistent feedback information coming from the MP activities and all other activities regarding the assets.

An auditing process should be structured based on the maintenance manual rather than on the maintenance program to respect the essence of the Global Service contract as a contract based on result's achievement.

### *Monitoring on-request activities*

The definition of a new service level agreement (SLA) and corresponding performance indicators (KPIs) for the on-request activities can generate a more effective activity and cost control of the Client. The required service levels should consider indicators based on time along with the measurement of the quality of the intervention on technical aspects and a measurement of the perceived quality by the internal client<sup>34</sup>. These standard levels, generated by the strategical figures of the contract (command center), should give a complete view of the Supplier's activities and the perceived consideration of the Supplier by the final users.

To correctly structure an auditing process the Client should correctly identify and declare its needs, structure the auditing team and define the roles and competences in the auditing process. This step could involve an internal analysis of the historical data and gathered experienced knowledge on the FM activities and an external research of the common best practices in market, these elements should help for a subsequent definition of benchmarks for the FM audits. The resulting analysis of the performances that arises from the audit should be shared with the Supplier through structured reports that explain the reasoning and the criticalities that emerged in the controlling process.<sup>35</sup>

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33 UNI 11136:2004 – GLOBAL SERVICE FOR THE MAINTENANCE OF THE REAL ESTATE – GUIDELINES; CHAP.3.2.13 MAINTENANCE MANUAL

34 EN 15221-3:2011; 4.2 CRITERIA, BACKGROUND, ELEMENTS AND INFLUENCES TO QUALITY

35 TRONCONI O., CIARAMELLA A. – FACILITY MANAGEMENT; PROGETTARE, MISURARE, GESTIRE E REMUNERARE I SERVIZI; MILAN – FRANCOANGELI, 2014; CHAP. 7 FACILITY MANAGEMENT AUDIT

### *Self-monitoring*

A global service agreement is an agreement that forces the Supplier to perform at specific levels, the relationship should be structured to allow the Supplier itself to reach these required levels. The Facility Manager is entitled to define and monitor the internal procedures for the ordinary and on-request activities. Since this aspect is already within the duties of the Client's strategical figures<sup>36</sup>, for a non-biased measurement of the performances of the contract and to allow the Supplier to reach the requested service levels, the command center (or the competent Strategical figure) should consider structuring performance levels to monitor its own service level towards the Supplier.

The requested service levels for the Client should be inserted in the SLA, monitored with defined KPIs<sup>37</sup> and the results of the monitors may be shared with the command center or kept internally. These indications can be used to solve issues regarding the relationship between Client and Supplier on a tactical and strategical level or, along with the monitoring of the Supplier, to allow the Client (on a strategical level or even the competent Client's executive responsible figure) to have a complete view of the whole Facility Management contract.

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36 TRONCONI O., CIARAMELLA A. – FACILITY MANAGEMENT; PROGETTARE, MISURARE, GESTIRE E REMUNERARE I SERVIZI; MILAN – FRANCOANGELI, 2014; CHAP. 7.2.1, P.103

37 EN 15221-3:2011; 3.1.14 CLIENT KEY PERFORMANCE INDICATOR (CLIENT KPI) – “INDICATOR THAT PROVIDES ESSENTIAL INFORMATION ABOUT PERFORMANCE OF THE CLIENT ORGANIZATION”

### 3. Information System and Accounting

The management of facility management activities cannot do without the adoption of an efficient informative system that supports and with which the relationship can be managed. The importance of these tools for the real estate management is underlined by the definition given by UNI of the informative system: “an instrument for operational and decisional support made of database, procedures and functions aiming to gather, process, use and update the necessary information for the set-up, execution and management of a maintenance service of a building or a real estate”<sup>38</sup>.

Every informative system that is correctly defined allows the users of the system to create a constant updating database of the data regarding the involved assets, manage the data to extract processed information that efficiently support the conduction of the activities and the management procedures and processes for the execution of the FM activities that are expected by the contract.

Through the information system all the data regarding the contract is implemented, verified and updated. “It is well known that the *conditio sine qua non* for an efficient Facility Management service is the development and management of a system of information concerning the dimensional, functional and technical characteristics of the Real Estate” (Talamo<sup>39</sup>). Having the correct availability to good information can sincerely make the difference in the efficiency of the contract. A wonderful dissertation of the issue of information quality has been given by Jylhä and Suvanto (2015), their analysis, focused on the impact that poor information on a lean management perspective, highlights the different wastes where information quality impacts giving a clear insight of the all-round benefits of good information. To correctly understand the meaning of a “good information” the following table, with the display of information’s attributes, can give a clear scheme to understand it.

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38 UNI 10951:2001 INFORMATIVE SYSTEMS FOR THE MANAGEMENT OF THE REAL ESTATE MAINTENANCE - GUIDELINES

39 TALAMO C., BONANOMI M. – KNOWLEDGE MANAGEMENT AND INFORMATION TOOLS FOR BUILDING MAINTENANCE AND FACILITY MANAGEMENT; MILAN – SPRINGER, 2015; CHAP. 3.1 P.46

<i>Attribute</i>	<i>Component</i>	<i>Key questions</i>
<i>Accessibility</i>	Mode and media	What is the information format? How is information distributed? How can information be accessed? Is information accessible when needed? Is information access restricted?
	Traceability	Can the data source be identified? Can original data be traced?
	Reliability	Is the information available when promised? Is the mode and media as promised?
<i>Contents</i>	Accuracy	Is the information free of error? Is the information content reliable?
	Uniqueness	Is the information the same for everyone? Is it possible to get customised information? Is it possible to benefit from the being only one having certain information?
	Relevance	Is the information something the user needs? Does the information help to solve the problem at hand?
	Completeness	How complete is the information? Is it deficient?
<i>Availability</i>	Coverage	How wide an area does the information cover? Does the information reach all relevant users?
	Volume	How much information is available? Are there multiple sources of information? How frequently is the information updated?
	Consistency	Is the information coherent and logical?
<i>Timeliness</i>	Real-time	Is the information provided in real-time?
	History	Is the information provided based on collected data of past events?
<i>Validity</i>	Unambiguous	Does the information include obscurities?
	Objectivity	Can the information be considered objective?
<i>Effectiveness</i>		Can the information affect its users' choices? Can the information make its user change his or her way of working? Does the information benefit its user? How?
<i>Cost</i>		Is the information free? How much does the information cost? Are the benefits of the information greater than its cost?

Tab. 8 - Framework of information quality attributes (adopted from Herrala, 2007; Herrala et al., 2009) (source: Jylhä and Suvanto40)



## 1. Introduction to the used Informative System

To manage the information flow between Client and Supplier, the Client requests the use of an IT platform for the planning, declaring, accounting and archiving process of all the work orders, whether they are on-fee or extra-fee. This platform, provided to the Supplier by the Client itself, works as a branch of the Client's ERP software, introduced in April 2016, that manages the flow towards an external entity, the Supplier has the possibility to operate through a specific ERP user interface designed for its purposes; all the ownership of the information that is managed through the information system is of the Client, who has complete visibility on the process and information flow.

The informative systems, on the Client side, is managed by the authorities that can issue requests of intervention towards the Supplier. The informative system allowed the Client to operate an efficient monitoring on the costs that the Supplier is charging to him and keep an efficient archive of all the requests that are issued. Moreover, it allowed to reduce the amount of e-mails and the use of other means of communications between Client and Supplier, the relationship is managed mainly on the platform and it is direct and unique, reducing the possible confusion that arises from an e-mail discussion with a generic user.

### I. Criticalities

Since the platform was introduced mainly for as cost control tool, it lacks the characteristics of support of the FM activities such a proper building registry and, most of all, does not manage the maintenance plan<sup>41</sup>. The ability to create a database of the interventions is not immediate and the information that the platform gives must be processed by the user to be adequately understandable; the platform mainly returns reports of interventions that are lists of data rather than structured information.

The Supplier is forced to interact with separate tools for the on-request activities and the maintenance program and this leads inevitably to inefficiencies.

The Client is left with incomplete information regarding the maintenance activities, number of interventions and workload of the Supplier.

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41 TALAMO C. – PROCEDIMENTI E METODI DELLA MANUTENZIONE EDILIZIA, VOL.2: IL PIANO DI MANUTENZIONE (AMBITI DI APPLICAZIONE, STRATEGIE E PROCEDURE); NAPOLI – SE-ESSELIBRI, 2010; CHAP.10

## 2. The work order and procedures

The procedures necessary to manage the works on the informative system reflect the ones that are described in the chapters above; these procedures are partially managed through the IT platform that has been provided to the Supplier. Therefore, it is important to understand the nature of a work order and its functionality to comprehend the procedures and the monitoring that is made by the Client towards the Supplier.

### I. The work order

A work order<sup>42</sup> is the document through which the Client interacts with the Supplier to request maintenance activities in its facility and through which the information on the maintenance activities are collected; it is an electronic document that, provided with the necessary information, must clearly define the needs of the Client and allows the in Supplier to execute the request.

The Client, once it has defined the needs and the urgency level of a specific fault/failure or loss of functionality in a system issues a work order, through its selected requesting entities, to request the intervention of the Supplier. A work order must be traceable, unique and clear to be correctly executed; it must contain at least the following information:

- UNIQUE SERIAL NUMBER – every request for intervention is unique and must be easily found when needed, this number is automatically generated by the platform
- CREATION DATE – is the date that the work order was instructed by the Client's requesting authority, this date is inserted automatically by the platform
- TIME FENCE FOR THE ACTIVITY – an activity can be planned in the days that are allowed by the time fence, this fence is decided by the Client's requesting authority when evaluates the request
- LOCATION OF THE INTERVENTION – Every location of the Client's facility is codified, there are codes and names for every building, floor and office/location; if a location cannot be specified it should be written in the text description

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42 EN 13460:2009 – MAINTENANCE - DOCUMENTATION FOR MAINTENANCE; WORK ORDER: DOCUMENT CONTAINING ALL THE INFORMATION RELATED TO A MAINTENANCE OPERATION AND THE REFERENCE LINKS TO OTHER DOCUMENTS NECESSARY TO CARRY OUT THE MAINTENANCE WORK STANDARD.

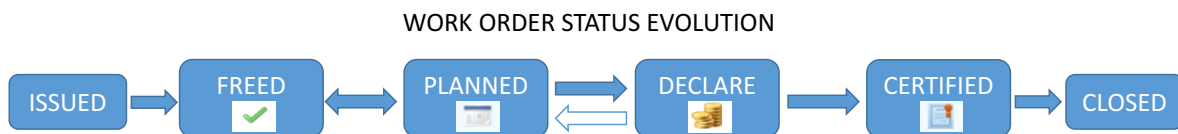
- **TYPOLOGY OF THE ACTIVITY** – plumber, electrician, etc., whether the work requires multiple technicians it is preferred to be written in the work description
- **FAULT DESCRIPTION** – as precise and direct as possible in order avoid time waste and confusion, the fault description must allow a successful execution by the technician
- **CLIENT’S REFERENCE** – if not present the Supplier refers to the Operative Contract Manager who issued the request

Once the intervention has been executed the work order must contain the sufficient feedback information on the executed activities:

- Description of the executed activities;
- Actual failure/fault detected;
- Resources used for the intervention (workhours and materials).

### Work order status

To efficiently identify the executed activities a work order can have 4 different statuses, visible on the Supplier’s platform, that represent the different stages in which the work order is found:



Tab. 9 - Evolution of the status of a work order; the arrows represent the status' interactions, explained in the text (source: J. Carrara)



- As the work order is created it appears on the user interface of the Supplier as “freed”, not taken in charge; this is the first status of a work order. While the work order is in this status the Client does not receive any feedback on the progress of the intervention.



- Once the Supplier evaluates the intervention and decides when to plan the work he can give a feedback to the client on when it will be executed, by who and how much time it is expected to last by inserting this information in the planning area of the user interface. The status of the work order changes and is now “planned” and the Client has access to all the information inserted by the Supplier on the planning status of the work order and can monitor the expected duration, the day of execution and the person who executes the activity.

If the Supplier removes the planned resources from the order the order goes back to the previous status of “freed”.



- As the activity is finished and the operator wrote a work report for the intervention, the Supplier analyses the costs of the intervention and, if he supposes that they are not included in the on-fee activities, can charge the costs on the accounting area of the user interface. The cost charging must be made on the date that the intervention has been planned; if the Supplier executes a work order in a date that has not been previously planned the system does not allow the declaration of costs. Once charged the costs, the status becomes “declared” and the Client receives the feedback of the amount of resources used and that the intervention has been executed. It is not mandatory, but it’s a common practice, that the work order is declared only when it is completed.

Once the costs are charged the work order cannot change status anymore; the work order can still be planned in other dates and the supplier can still declare other costs on the order.



- The Client approves the declared resources through the system and issues a certificate that justifies the payments toward the Supplier. The work order is now in the status of “certified” meaning that the Client has approved the payments of all, or part, of the costs charged by the supplier.

The Supplier can verify which costs have been certified, which rejected and which are still pending. Once the certification the client could continue with the planning and declaring of the costs but it is not recommended to avoid misunderstandings in the cost certification process of the Client.

## II. Executing the work order

As a need is detected an authorized user creates a request through an appropriate interface that dialogues with the Client’s ERP. In this way, the user can send its requests to the competent Requesting authority for the creation of a work order towards the Supplier.

The Supplier relates with a user interface where he sees all the open work orders in the system [Fig.18]; if needed he can update the data from the ERP to control if the Client issued new work orders (the system automatically refreshes the interface at the beginning of the working day and at lunch time). In the following image, it is shown the home page of the user interface of the Supplier; there is a list of orders that can be organized by serial number, characteristics, description, etc.

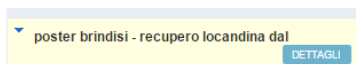
Every order has its status that is shown in the “stato” column at the end of the row and it is characterized by the images that have been explained in the specific paragraph in section 3.2.1.

The screenshot shows a web application interface with a navigation menu at the top (Home, Pianificazione, Consuntivo, Reports, Settings, Help) and a date indicator (venerdì 23 dicembre 2016). Below the menu is a 'Home' section with a 'Settings' dropdown and a 'Visualizzazione corrente: Default' indicator. A table titled 'Trascina qui una colonna per raggruppare' displays a list of work orders. The table has columns for Description, #Ord. - #OP, Responsabile, Gruppo pianificazione, Location\_Dess., Nr. Doc., Cod. controlli, Data inizio, Data fine, Priorità, and Stato. The table contains 10 rows of work orders, each with a status icon in the 'Stato' column. At the bottom, there is a pagination bar showing 'Pagina 4 di 28' and buttons for 'Aggiorna Operazioni Rilasciate' and 'Aggiorna i dati da SAP'. The total number of elements is '31 - 40 di 272 elementi'.

Descrizione	#Ord. - #OP	Responsabile	Gruppo pianificazione	Location_Dess.	Nr. Doc.	Cod. controlli	Data inizio	Data fine	Priorità	Stato
Work Order 1	010104880172_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	16/12/2016	28/12/2016	4	[Icon]
Work Order 2	010104880335_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX04	16/12/2016	22/12/2016	2	[Icon]
Work Order 3	010104880331_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	16/12/2016	28/12/2016	4	[Icon]
Work Order 4	010104879057_0010	Oper. Control Mng.	RespPianificazione	MISTE-PIAN	6700159758-1	EX02	15/12/2016	15/12/2016	2	[Icon]
Work Order 5	010104879124_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	15/12/2016	30/12/2016	3	[Icon]
Work Order 6	010104879122_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	15/12/2016	30/12/2016	3	[Icon]
Work Order 7	010104877671_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	14/12/2016	18/12/2016	3	[Icon]
Work Order 8	010104884550_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	14/12/2016	29/12/2016	4	[Icon]
Work Order 9	010104876331_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	13/12/2016	18/12/2016	2	[Icon]
Work Order 10	010104876334_0010	Oper. Control Mng.	Servizi Generali	SEGE	6700159758-1	EX02	13/12/2016	18/12/2016	3	[Icon]

Fig. 18 - Screenshot of the home page of the user interface (source: Client)

As the Supplier notices a new work order he opens the information box by clicking on “dettagli”,



This opens a popup window that allows to read the information on the request: typology, description, location and time fence for the activity (start date, finish date).

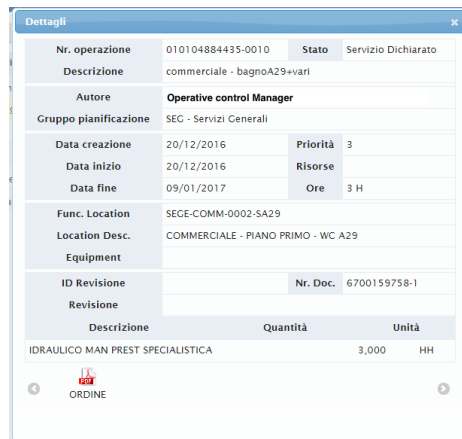


Fig. 19 - Work order details on the user interface (source: Client)

If the information is sufficient the Supplier can proceed to print the physical order sheet and plans the work for the operator.

Planning is done by double clicking on the request and going on the planning section, that is shown in the following image

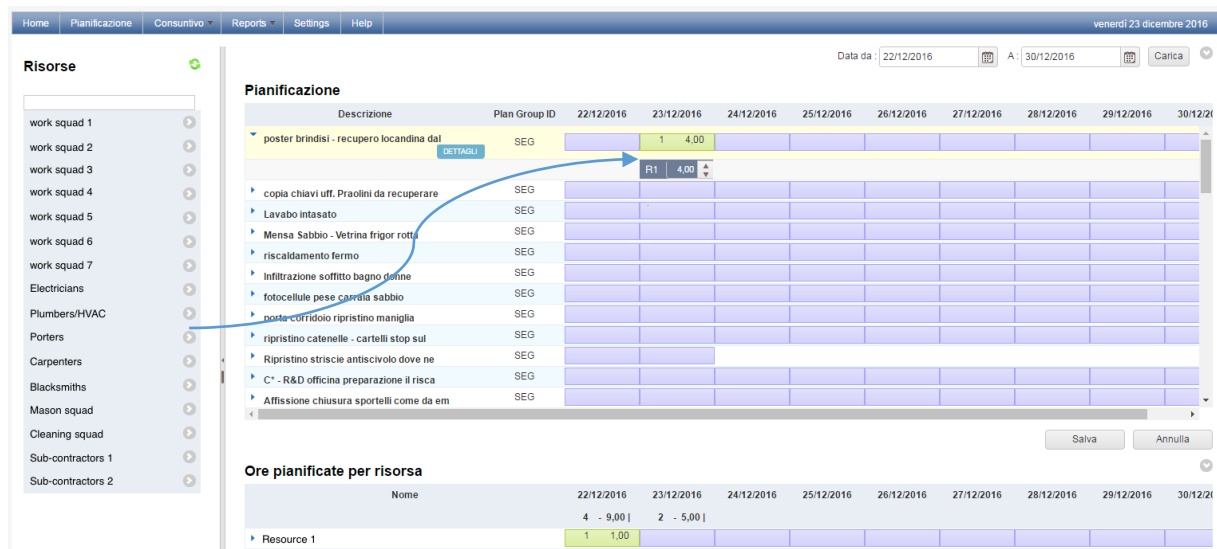


Fig. 20 – Screenshot of the planning interface with drag&drop system described by the arrow (source: Client)

In the first row the Supplier sees the work order that has been double-clicked and the associated days of its time fence where the work can be planned. On the left side of the window there is a panel where the available resources are listed and divided in “squads”; to plan activity the supplier only needs to select the required resource from the list on the left, drag and drop it on the planned day and declare an expected time for the execution.

In the following rows, all the orders that have at least one day in the selected time fence are displayed. In this way, it is possible to manage the workload and the interferences between the operators and the different activities.

As the work is planned the request changes status and becomes “planned”, the work can be planned in more than one day and with different, even multiple, resources. If the planning is not respected the Supplier can reprogram the work or eliminate the planned resources, in this case the request returns to the “freed” status.

The order, scheduled, once printed is handed to the operator, along with a work report form, in the day of the execution and executed; the operator returns the printed request and the work report filled out to the office staff for the closure of the request.

If at least one day has passed from execution of the order the Supplier can proceed to close the work order, if it is an on-fee activity, or, if the activity is considered extra fee, charge to the Client the required resources.

### III. Criticalities

The process to receive and execute a work order is correctly functioning and can be easily managed by the Supplier. There are different issues, though, that complicate the work and reduce the dialogue between Client and Supplier through the informative system.

The user's interface is based on a software that is entirely managed, designed and owned of the Client; the permissions allowed by the Supplier are minimum, very rigid and not entirely suited for facility management activities.

#### *Feedback information*

As specified in the previous paragraphs, the work order should contain all the feedback information on the executed activities once the intervention has been cleared. In the "as is" situation most of this information is lost or has poor possible to be introduced in the informative system provided by the Client.

The information based on the preventive maintenance is held on the IT tool of the Supplier, where he reports the type of activity executed and possible issues regarding the intervention. The information based on the on-request interventions is kept on the physical work order by the Supplier but cannot be transmitted through the informative system to the Client; the provided user interface does not have a structured area where a description of the intervention is made. All the information must be transmitted verbally or via e-mail.

#### *Limited planning operations*

This is a coherent limitation if the planning of all activities is managed on the IT platform, but, as shown and explained in the 2.3 paragraph, there are several requests both of ordinary and extra ordinary maintenance that can be issued outside of the informative system.

This generates several work orders that are instructed on the informative system after the material execution of the intervention. Taking into consideration the mandatory planning to allow the charging of costs, the clocking control system that does not allow charging of extra hours for a resource and the will of both the Supplier and Client to keep trace of the executed activities, it is straightforward understanding that the order must be planned in the effective execution date. To do so the Supplier must request an authorization to the Client, that issues a permission on the informative system that allows the Supplier itself to plan for a specific amount of days in the past. This authorization must be renewed every day or twice a day according on when the ERP system reboots.



### *Planning control*

The Client has the possibility to monitor the planning of the requests and verify when they are going to be executed. Whether the Supplier cannot execute the requested interventions in the planned day, he can modify the planning as he pleases. The request may be delays within the time fence without that the Client takes notice of the act.

In this way, the Client is not able to easily detect delayed work orders that may lead to problems with the internal client or to detect issues that the Supplier is having in the execution.

### 3. The accounting process

The design of the informative system should maximize the intervention's flexibility in the system during the data process and execution of the activity, also should allow the declaration of the volumes and costs of resources to:

- Control costs;
- Variations on the estimated cost of intervention, if any.<sup>43</sup>

The payment of the executed activities is done through the same interface as for the planning and execution. The payment solutions adopted in this study case are various:

While all the MP activities and all on-fee activities are included in the monthly fee that may vary based on the performance of the Supplier; on-request extra-fee activities may be paid to benefits (for extra-fee the worked hours), with cost+markup (for extra-fee materials), on behalf of a cost estimate (mainly for complicated requests) or through lump-sum for standardized contracted activities<sup>44</sup>.

The Supplier has the possibility to charge costs to the Client once an on-request activity is executed if he thinks that the activity is considered extra-fee. The final accounting made by the Client should consider the adequate UNI structure given by norm UNI 10992:2002 chap. 10 that defines the final accounting required information to efficiently charge the costs to the Client. The operation is done through the Supplier's user interface in the section "*consuntivo*". This section is divided in two subsections: one for charging the resource's working hours and one for all the other services. The charging of costs is made through arranged contract lines that are defined within the contract; these lines define the cost, measure unit and definition of each resource that can be used by the Supplier when executing the work orders.

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43 UNI 10992:2002 MAINTENANCE BUDGET FOR MANUFACTURERS AND SUPPLIERS OF PRODUCTS AND SERVICES - GUIDELINES FOR THE DEFINITION; CHAP.10 INFORMATIVE SYSTEMS

44 TRONCONI O., CIARAMELLA A. – FACILITY MANAGEMENT; PROGETTARE, MISURARE, GESTIRE E REMUNERARE I SERVIZI; MILAN – FRANCOANGELI, 2014; CHAP. 4.2

## I. Working hours

The integration in the informative system of the worked hours should be done on daily basis, the information regarding the working hours should consider all inactive hours with the corresponding motivations.

The implementation of the worked hours in the informative system is efficient if:

$$\frac{\text{total hours implemented in the system}}{\text{total working hours based on the clocking system}} \rightarrow 1$$

The Supplier enters the correct subsection, called “risorse” [resources] and selects the date when the work has been executed, this date must be strictly in the past. The window shows the work orders that are planned in the selected date and the planned resources associated to the work orders.

Descrizione	Nr. richiesta	Nr. Doc.	Pianificate (hrs)	Consuntivate (hrs)
luci tettoia portineria centrale Vezzoli	010104880174-0010	6700159758-1	2	0
commerciale - bagnoA29+vari	010104884435-0010	6700159758-1	1	1
Resource 1			46	1,00
PLUMBER			1,00	
Neon esausto Fagnani	010104884543-0010	6700159758-1	1	0
Luce bruciata nelle scale che dal piano	010104885602-0010	6700159758-1	1	0
Distribuzione Flash domani, entro le ore	010104885671-0010	6700159758-1	4,00	0,00

Fig. 21 –Screenshot of the user interface worked hours declaring section; note that the column of the planned working hours (pianificate) and the column for the declared ones (consuntivate) are different and may not be coherent (source: Client)

On the left side of the window the Supplier has a drop-down menu that lists all the workers that are available on the selected date (meaning that the listed resources have worked for the Supplier within the Client’s facility in that specific date – ex. in the image is the 22/dec/2016). The Supplier can proceed to add workers to the work order, if necessary, and specify the contract line required. In this section, it is possible to choose only contract lines that can be combined to a specific worker and are paid by hours.

Once selected the appropriate contract line the Supplier proceeds to declare the number of hours that the worker spent for the intervention in the selected day. The system verifies the worked hours through the effective clocking times of the worker in the facility and allows or denies the charge of the amount declared by the Supplier. It is not possible to declare more hours for a resource than the effective hours that that resource spent within the boundaries of

the Client's facility. Once the Supplier finishes to charge the amount required in the date selected he must click on the save button to send the data to the ERP and so to the Client for approval.

The charging of the working hours is monitored by the Client's clocking system that is integrated in the ERP. This system requires that the resource works inside the Client's turnstiles and clocks in and out every time the resource passes the turnstiles in a specific stamp machine that registers the presence with a card that declares that the resource is working for a specific supplier. Moreover, the clocking system deducts time from the total amount in two different cases: it eliminates 15' (fifteen minutes) from the Supplier's resource in the first and last clocking due to a supposed walking time that the resource takes to reach the workshop; it deducts the lunch break if the resources continuously stays in the facility for more than six hours. If one of these conditions does not occur the Supplier is not able to charge the worked hours towards the Client.

## II. Materials and Standardized Services

To charge all type of costs that are not working hours towards the Client the Supplier should enter the second subsection of “consuntivo” that is called “servizi” [services].

In this section, the Supplier finds a list of all work orders that are visible in the user interface, ordered by emission date, and a menu where he can select a date.

The date shown in the menu represents the date from which the orders are shown (only orders from the selected date and past are shown, not after)

Descrizione	Autore	#Odl - #OP	Gruppo pianificazione	Nr. Doc.	Cod. controllo	Chiusa
Migrazione licenza Desigo+PC	DALLOP	010104656484_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>
▶ MENSA - installazione parapetti	DALMOI	010104668161_0010	Servizi Generali	6700159758-1	EX04	<input type="checkbox"/>
▶ Porcarelli :	DALGIU	010104775238_0010	Servizi Generali	6700159758-1	EX04	<input type="checkbox"/>
▶ Fondazione varie Tonolini	DALGIU	010104775263_0010	Servizi Generali	6700159758-1	EX04	<input type="checkbox"/>
▶ preventivo cabina 45 per :	DALGIU	010104776183_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>
▶ pesa ferroviaria	DALGIU	010104776187_0010	Servizi Generali	6700159758-1	EX04	<input type="checkbox"/>
▶ Mensa Sabbio - Piastrina rotta in pross	DALGIU	010104779223_0010	Servizi Generali	6700159758-1	EX04	<input type="checkbox"/>
▶ C* pulizia uffici progrFTM	DALGIU	010104785738_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>
▶ rotta maniglia porta - bloccata chiusa	DALGIU	010104794765_0010	Servizi Generali	6700159758-1	EX04	<input type="checkbox"/>
▶ CRAL - Caldaia porta cerniere rotte	DALGIU	010104796045_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>
▶ montacarichi guasto	DALLOP	010104796284_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>
▶ fan coil corrosione	DALLOP	010104797102_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>
▶ gomma bolli sollevata	DALLOP	010104797104_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>
▶ SARRIO-modi oliviate	DALMOI	010104801002_0010	Servizi Generali	6700159758-1	EX02	<input type="checkbox"/>

Fig. 22 – Screenshot of the material and service declaring section in the user interface; the work orders are organized by date of issuance (source: Client)

The supplier proceeds to find the correct work order where he will charge the services and clicks on the blue arrow on the left side of the selected order. This opens a sub-row where the supplier can select the contract line desired; all the contract lines available in this section are the ones that do not involve the declaring of a specific operator that executes the work, this comprehends general material costs and standardized activities or fees. The costing of the activities in this section is made on with cost+markup or by lump sum. The activities which cost has been agreed with a cost estimate are managed on this section.

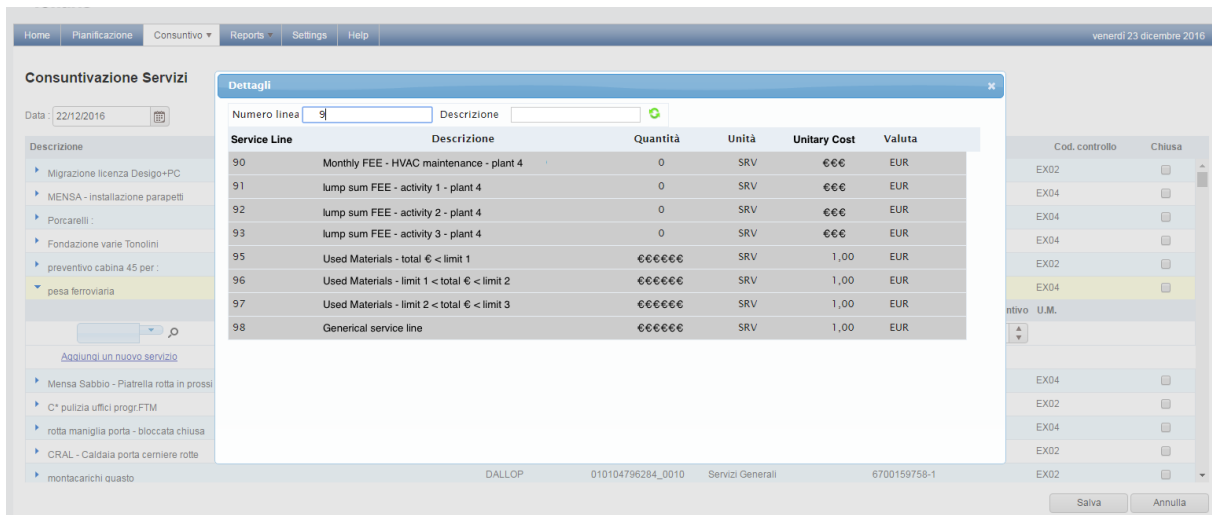


Fig. 23 - Screenshot of the selection of the required material contract line; note the differences in the unitary cost of the contract line according to the service line required (source: Client)

To dialogue correctly with the system, the Supplier must declare not the economic amount requested but the amount of contract line desired based on the standard unit and unit of measure of the line selected.

For specified standard works, as for the moving of a work station, the unit of measure is the activity (ex. 1 moving of work station = 1 unit) and the Supplier declares how many units of the activities he has performed. The activity and its cost have been specified and accepted by the Client in the commercial offer that the Supplier made when subscribing the Contract so the Supplier itself receives the correspondent amount that has been agreed and can be found both on the contract itself and written on the user interface when researching the contract line.

For material costs the Supplier has insert the exact economical amount required (that is the sustained costs and the corresponding markup) because the system considers as unit of measure the currency (ex. 1 unit = 1 €).

The main difference between the two types of contract lines is that the first ones are rigidly described and standardized in the contract, while the second does not have a specific requirement or contract definition; on material cost the Supplier can charge the cost of the bought materials plus a contract defined mark-up but, unless the Client demands one, he is not intended to justify the costs charged.

### III. Cost certification

Once the Supplier charged the costs to the Client, they must be certificated by the latter to allow the Client’s purchasing entity to proceed with the payment. This step, most of the times done monthly, is critical for the Supplier not only for the economical purpose of the process but also because it is the moment where the different requesting authorities (Civil FM, Industrial Maintenance and Informative Systems) operate a cost control on the work orders that have been executed. The Supplier must be able to correctly justify costs charged even 20-30 days prior the control to receive the appropriate economical consideration, this may not be easy within the maze of the un-organized data of number of work orders, different interventions, different requesting authority.

Once the competent authority has certified the costs on the work order the status of work order itself changes on the informative system.

The Client can certify all the costs linked to an order as well as only the single contract lines that have been charged. The Supplier can verify on its user interface which lines have been certified and which have been eventually rejected by checking the single work order in the working hours’ section or on the service section.

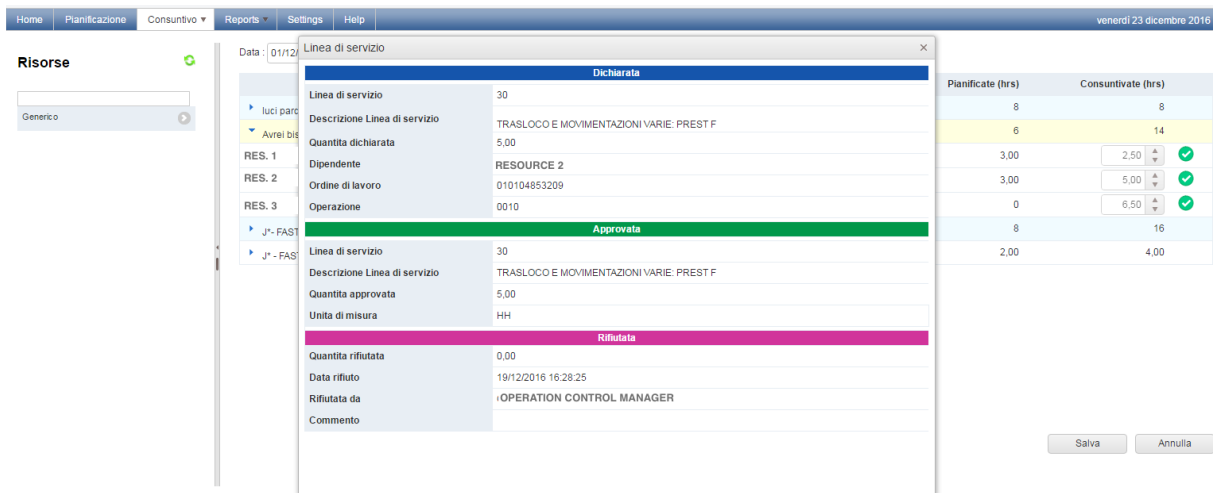


Fig. 24 - Screenshot of the certification control panel in the worked hours declaring section; the Supplier can visualize the approved quantities and the rejected quantities with the motivation, if any (source: Client)

As shown in the above image the system generates a green mark ( ✓ ) at the approved lines and a triangle mark on the rejected ones; by clicking on this element the Supplier can visualize the amount certificated or rejected and the motivations of the rejection. The image shown above takes as example a certification of working hours, the certification of materials and standardized services has the same functioning.

In the situation that is taken into analysis in this document, every single entity of the Client has a spending power in matter of maintenance, or general building operations, that can be used as preferred; the requesting authorities, that have a direct relationship with the Supplier, other than managing their own available budget, have the duty to address and verify all the costs that are charged from the Supplier to the Client's entities. Of all these entities though, none has actual permission to pay an invoice towards an external supplier; the actual payment can be executed only by the Client's purchasing entity after the cost certifications have been issued.



#### IV. Criticalities

The main criticalities perceived by the parts concern the clocking control system and its interaction with the ERP. After studying the case I could define the cases in which the clocking control system created discomfort in the accounting of the activities, listed in the following paragraphs, and other criticalities regarding the accounting process of the interventions.

##### *Intervention outside of the Client's turnstiles*

Clocking in and out the client's facility is mandatory for the Supplier's resources. For this reason, when the Supplier is intended to work outside the facility or exits the facility to buy materials for an intervention, there may be issues on charging the effective worked hours towards the Client.

To solve the problem, the Supplier should notice the competent requesting authority of the problem; the authority verifies the clocking in and out of the specific resource in the requested day and "connects" the clockings to allow the Supplier to charge the requested worked hours.

##### *Missed clocking*

The clocking control system analyses every clocking and recognizes the entries and the exits of a resource simply by alternating the clockings. It is immediate to understand that the clockings must be always of an even number, to start with an entry and finish with an exit.

In case that one of the Supplier's resources, or subcontractors, doesn't clock in or out properly, the clocking control system cannot correctly calculate the worked hours since it does not recognize the last clocking as an exit. For to the nature of the activities requested to the Supplier, its need to purchase material from external suppliers and the specific procedures that the Client requires when checking in in the facility, this problem has been quite common in the months that followed the adoption of the ERP.

Though the issue can appear to be straightforwardly detectable, it was only raised after six to nine months from the adoption of the clocking control system; mainly due to two factors: first the billing of the interventions through an informative platform has grown significantly from the adoption of the ERP's user interface; secondly the charging of the worked hours, in accordance with the requesting authority, was not done correctly in the starting period of the system (Supplier could insert generic resources in the system without declaring the exact resource that executed the intervention), with an increased monitoring of the interventions from the Client this procedure has been prohibited.

To solve the problem, the Supplier must notice the Client of the omitted clocking, the clocking must be inserted manually by the Client after the clocking time is approved by the Contract Manager and then by the Facility manager. Once the clocking has been inserted, the Client verifies that the system correctly calculates the worked hours for the Supplier and eventually proceeds to eliminate “holes” from an external activity.

#### *Clock in with a different card*

All the resources that work for the Supplier have a card that should be used in the clocking in and out of the facility. This card states that the resource that is clocking in is working for the Supplier and so the ERP can allow the Supplier itself to charge the worked hours to the Client. For some activities, rarely, there are companies that are both direct contractors of the Client and Supplier’s subcontractors; apart from creating an ambiguous relationship between the parts involved, the resources have two different cards that state the two different conditions in which they are entering the client’s facility. In case one of these resources, entering to work for the Supplier, does not clock-in with the Supplier’s card, his work cannot be claimed by the Supplier and therefore cannot be correctly charged to the Client for the intervention made. This situation is not easily solvable from the ERP and therefore the Client and Supplier agree to solve the issue in one of the following: make an invoice that is out of the informative system or not charging the worked hours in the appropriate section and charge the monetary equivalent as materials.

#### *Cost Certification*

The Client’s requesting authorities do not verify the effective payment towards the Supplier since their duty is only to certify the costs. If there is a situation where the annual budget for a specific cost has already been spent but the Client’s requesting authority certified a cost (meaning that a work has been done and the Supplier can claim its financial consideration) the Supplier may not receive the expected monetary amount until a new annual budget is approved or an extra ordinary expenditure is issued. Obviously, this situation is not manageable for a Supplier so, in accordance with the competent Client’s Authority, both parts reach an agreement that involves an extra system invoice or the charging of the costs on different contract lines that have enough availability.

#### 4. Supplier's improvements

The Client's informative system is structured to manage the information flow between the two parts of the contract and to allow a smooth execution of works without waste of resources and economic value. As already said before the system was totally created and managed by the Client to efficiently monitor the supplier's works; this brought the Supplier to adapt and structure some tools to improve and to compensate some of the inefficiencies that stemmed from the rigidity of the Client's ERP platform.

##### 1. Office organization

The office staff divided its competences to increase the efficiency and reduce lead time of the interventions; the assistant contract managers would manage all the information flow through the informative system in matter of planning, costing and certification control, take care of the workload of the on-site unit and plan the daily activities. The contract manager is free to operate on strategical level with the client and control all the activities that required the presence of an external subcontractor, the only operative activity that the contract manager follows are the works that have are critical for a system or on economic terms.

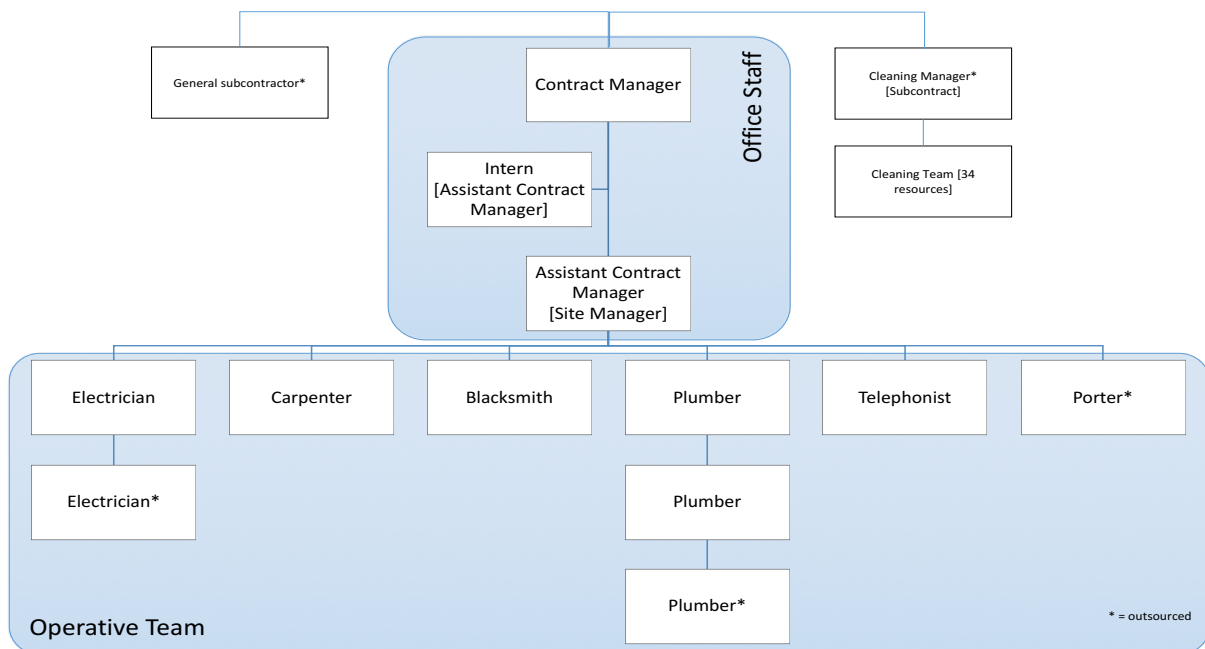


Fig. 25 - Office organization chart (source: J. Carrara)

The above image shows the adopted structure for the Supplier to plan and manage the received work orders. All the elements on the operative team are intended as equally independent, there are some outsourced elements that are considered peers of the internal ones.

## II. Planning

To manage the criticalities that arise from the use of the IT platform provided by the Client the Supplier developed some tools and procedures that adapted more efficiently to his necessities in the organization of the planned works.

### Planning support tool

The first tool that the Supplier created was a planning support tool that is totally managed by the Supplier's assistant contract manager and not shared with the Client nor the internal technicians. This tool is created on a spreadsheet and gave the sufficient flexibility and information access that the Client's user interface could not provide in its planning section; along with a division of the competences inside the office and a new internal planning procedure, the tool is used to manage the work of the internal operators that are part of the on-site unit and support the assistant contract manager in the planning on the ERP user interface.

Row	Time	Operator	Task Description	Task ID	Operator	Task Description	Task ID	Operator	Task Description	Task ID
352	14:30	personale Pellegri								
353	15:00									
354	15:30									
355	16:00									
356	16:30									
357	17:00									
358	17:30									
359	18:00									
360	18:00									
361	08:00									
362	08:30									
363	09:00	Dalmine Spogliatorio	Verificare cabina 45 che probabilmente slitta ad oggi	UTA Ripristino funz. motore magazzino CED		Dalmine - Lampada bruciata+ interrutt nn funziona	10104810866			
364	09:30	capitolo 77 sistemazione n° 2 finestre								
365	10:00									
366	10:30									
367	11:00									
368	11:30	Farro Michele: Sostituzione Serratura		Turca Intasata		Dalmine - Lampada Bruciata in Corsia	10104810868			Dalmine - Pulizia laboratorio CSM + Cherif
369	12:00					Dalmine - Uff. Bomboloni - sostituz. Luce uomini	10104810865			
370	12:30					4 Lampade bruciate scala	10104815710			
371	14:00	Direzione: finestra Scalone - sopralluogo				Lampada Bruciata:	ORD.10104808238 + Jose			
372	14:30									
373	15:00									
374	15:30									
375	16:00									
376	16:30									
377	17:00									
378	17:30									
379	18:00									
380	08:00									
381	08:30									
382	09:00									
383	09:30									
384	10:00									
385	10:30									
386	11:00	Fondazione: Movimentazione da villa 19 a villa 20 - ORD. 10104815699 + Diop								
387	11:30									
388	12:00									
389	13:30	Sabbato: installazione ORD.								
390	13:30									

Fig. 26 - Screenshot of the planning support tool; the row "Mercoledì" (Wednesday) defines the workday, the columns are divided by operator; the information in the squares are the minimum required to trace the work order in the information system (source: J. Carrara)

The spreadsheet, shown in the image above, is structured in the following way: Every month has a specific work sheet, on the first column there are indicated the days of the month. All the operators that form the on-site unit are listed in the first row and have each a column dedicated and a color according to their typology (blue for plumbing, orange for electrician, grey for carpenter, violet for blacksmith, green for porter); even though the construction worker (pink) is not considered strictly on-site and its works are entirely provided

by a subcontractor, due to the amount of interventions that require his presence alongside an on-site technician and the increasing presence of the operators in the on-site daily activities, it has been included in the spreadsheet. This structure forms a grid between days and workers and allows to comfortably check the daily planning, monitor the workload and verify interferences between the technicians.

To estimate the daily workload of each operator the days have been divided in 18 half-hour blocks, the planner may insert a work order in free spot and merge the required blocks of the spreadsheet to represent the amount of time estimated to execute the intervention.

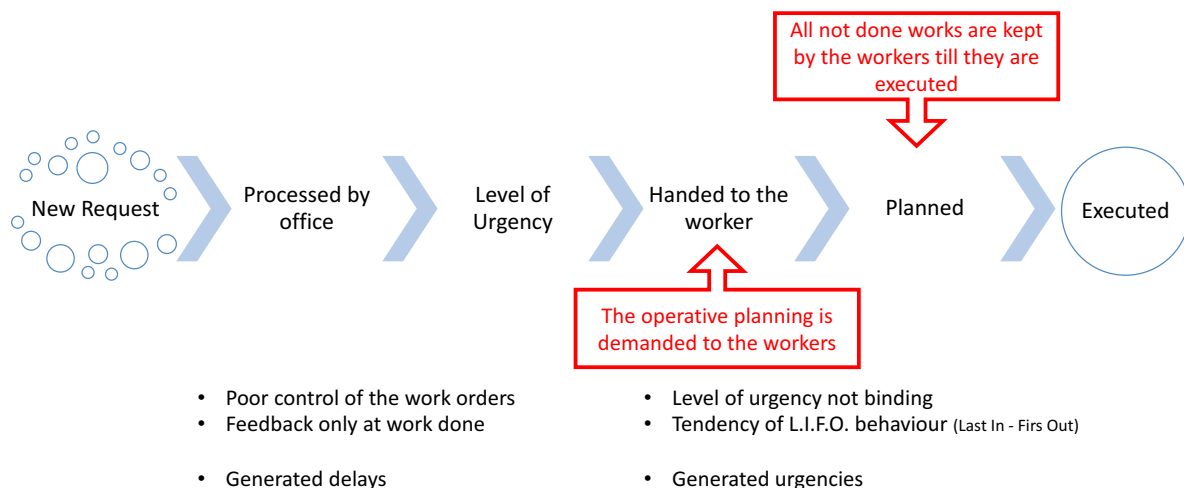
All the activities are inserted manually by assistant contract manager by writing the location of the intervention, a brief description of the work or inserting keywords, the serial number of the ERP work order or, if the serial number is not available, the competent requesting authority and the means through which the request has been issued (phone or email).

The insertion of the described tool allowed the planning to be monitored more efficiently by the office staff and to introduce a new internal procedure on intervention planning between office staff and technicians.

### Old planning procedure

One of the issues regarding the management of the activities was linked to the Supplier's internal procedures to plan the requested interventions.

The old planning procedure [Tab.10] didn't require planning for all the interventions, the work orders were printed and delivered to the operators with a rough planning or no planning at all if the intervention was not urgent, they kept the orders until they were able to execute it and returned it to the office staff after.



Tab. 10 - Old planning procedure chart (source: J. Carrara)

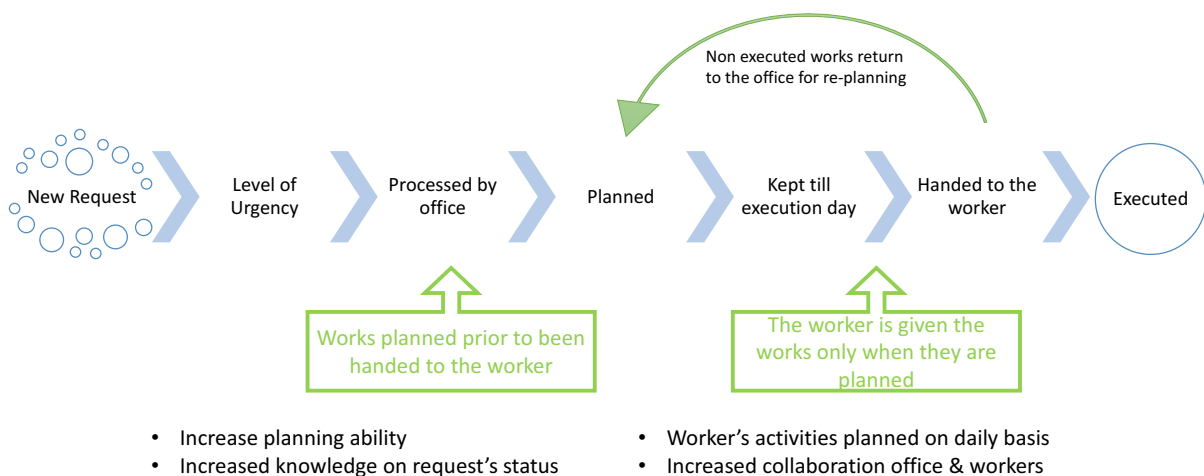
This system was inadequate and inefficient both for the Client and the Supplier, it generated a poor management of the information on the executed interventions, poor knowledge on the status of the requests, confusion among the requests issued by the Client and generated various delay complains and subsequent urgencies.

In the image shown above for “planning” is intended the planning the operator does independently, the office staff intervenes on the operator’s planning when there are substantial delays or a work in team is required.

This procedure was adopted for all on-fee activities, for some extra-fee activities and for the MP activities. The technicians had to manage all the paper requests that the office staff handed them with poor knowledge on the requestor or the urgency level (in not highly urgent, in that case the technician was noticed of the urgency level and had to carry out the request as soon as possible). This could lead to the loss of the physical paper request and a consistent loss of information by the Supplier; the loss of a MP activity, apart from the loss of information, could lead to delays or even a non-fulfillment of the MP monthly requested activities and therefore, if discovered by the Client, to economical penalties for the Supplier.

### *New planning procedure*

The new procedure [Tab.11] is intended to remove the criticalities described earlier and increase knowledge for the Supplier. The changes moved all the planning duties to the office and left the operators with the material execution of the interventions; all non-executed work orders are returned to the office to allow the assistant contract manager to be aware of possible delays and properly adjust the future planning.



Tab. 11 - New planning procedure (source: J. Carrara)

As the work order arrives the information is processed by the office to correctly plan the intervention according to the workload, urgency and availability of the on-site unit personnel. Once the planning date and the technician for the intervention are decided the office staff plans the intervention on the spreadsheet and on the user interface of the ERP.

Daily the assistant contract manager meets with the operators and hands them the work orders that are planned for that day specifying eventual details, requirements or teams when needed. The technicians execute the various interventions organizing themselves under the provisions given by the office staff and at the end of the working day they must return all the sheets received and the filled work reports.

One of the major changes that were introduced by the new planning procedure was the management of the MP activities through the daily planning tool. The monthly MP is scheduled with the planning tool and fixed according to the Suppliers needs and possibilities; in this way, the MP activities can be monitored and correctly prioritized by the office staff to avoid delays in the executions that could provoke an economical penalty.

Through this simple change of procedure, the workshop can react quickly to Client's requirements and the increased monitoring activity. The Supplier has a significant greater knowledge on the works that are in progress, pending or finished to give the answer the Client's verifications; the Contract Manager, though is always kept aware and monitors the operations of the assistant contract manager, can keep his focus on critical requests, subcontractors, internal accounting and on the strategic relationship with the facility manager.

### III. Accounting

The management IT platform available to the Supplier did not satisfy the needs for the management of the accounting of all costs declared to the Client. The Supplier did not have the possibility to verify in a fast and clear way the total charged costs, which costs have been certified, the total accounts receivable; this kept the Supplier without the knowledge on his performance and did not allow any control of the monthly amounts received.

The verification of the certified extra-fee payments was made on random samples without a full knowledge of the total expected amount.

#### Accounting support tool

To solve the criticalities the Supplier needed a support tool that could make the accounting information more accessible, verify the accounting status of the work orders and control the effective payments received from the Client; with these needs the Supplier himself structured a spreadsheet that listed all the works that have been received, executed, billed and paid. This simple tool had the goal to trace all the interactions that the Supplier has with the ERP's user interface on the matter of cost declaring and accounts receivable; the tool is not for controlling the operative status of the work order but only has an accounting purpose. The spreadsheet allowed the Supplier to monitor the whole work order accounting process, extra-fee accounts receivable and verify that the certifications made by the Requesting authority where paid; since the tools is modifiable and flexible, it improved in time to give feedback that are more complex and interesting to the Supplier.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
	DESCRIZIONE	N° ORDINE	DI	DELE	MESE ORDINE	REAZIONE	ESEGUITA (S/M/O)	CONSUNTIVATA	MANDOPRESA	MATERIALE	IMPORTO €	MESE CONSUNTIVAZIONE	CERTIFICATA	MESE CERTIFICAZIONE	NOTE
74	Boccioni piano Basso	10104929127	13/01/17	13/01/17	1	0	SI	SI	€	23,43	€	23,43	GENNAIO	SI	GENNAIO
75	IN CARTE VILLA 20, area distesa	10104929125	26/01/17	26/01/17	1	0	SI	SI	€	23,43	€	23,43	GENNAIO	SI	GENNAIO
76	IN CARTE VILLA 20, area distesa	10104929124	26/01/17	26/01/17	1	0	SI	SI	€	152,28	€	152,28	GENNAIO	SI	GENNAIO
77	Doppiofascio fari	10104929133	13/01/17	12/01/17	1	0	SI	SI	€	164,06	€	164,06	FEBBRAIO	IN ATTESA	
78	IN CARTE VILLA 20, area distesa	10104929122	26/01/17	26/01/17	1	1	SI	SI	€	180,81	€	180,81	FEBBRAIO	IN ATTESA	
79	Chiusa Basso	10104929121	26/01/17	24/01/17	1	2	SI	SI	€	46,86	€	46,86	FEBBRAIO	IN ATTESA	
80	Assistenza piano portiniera	10104929198	26/01/17	30/01/17	1	4	SI	SI	€	58,86	€	58,86	GENNAIO	SI	GENNAIO
81	IN CARTE VILLA 20, area distesa	10104929197	26/01/17	27/01/17	1	1	SI	SI	€	47,80	€	47,80	FEBBRAIO	IN ATTESA	
82	Assistenza fornici portiniera	10104929197	26/01/17	26/01/17	1	0	SI	SI	€	47,80	€	47,80	FEBBRAIO	IN ATTESA	
83	Missione FAST, Dalmine e Sabbio	10104929196	26/01/17	27/01/17	1	1	SI	SI	€	115,15	€	115,15	FEBBRAIO	IN ATTESA	
84	Palazzo e macero Valerio	10104929059	26/01/17	08/02/17	1	13	SI	SI	€	23,43	€	23,43	GENNAIO	IN ATTESA	In attesa ore di
85	Boccioni Piazza Fila	10104929057	26/01/17	25/01/17	1	3	SI	SI	€	105,00	€	105,00	GENNAIO	IN ATTESA	
86	Bagno disabili portiniera	10104929056	26/01/17	26/01/17	1	0	SI	SI	€	27,86	€	27,86	FEBBRAIO	IN ATTESA	
87	IN CARTE VILLA 20, area distesa	10104929055	26/01/17	01/02/17	1	0	SI	SI	€	46,86	€	46,86	FEBBRAIO	IN ATTESA	
88	IN CARTE VILLA 20, area distesa	10104929054	26/01/17	24/01/17	1	0	SI	SI	€	46,86	€	46,86	FEBBRAIO	IN ATTESA	
89	Assistenza in sala macchina	10104929025	26/01/17	24/01/17	1	0	SI	SI	€	35,83	€	35,83	GENNAIO	SI	GENNAIO
90	Assistenza in sala macchina	10104929024	26/01/17	26/01/17	1	1	SI	SI	€	32,80	€	32,80	GENNAIO	SI	GENNAIO
91	controllo e sistemazione riscaldamento villa 23	10104929023	26/01/17	26/01/17	1	1	SI	SI	€	32,80	€	32,80	GENNAIO	SI	GENNAIO
92	controllo e sistemazione riscaldamento villa 19	10104929022	26/01/17	26/01/17	1	1	SI	SI	€	32,80	€	32,80	GENNAIO	SI	GENNAIO
93	Assistenza sala macchine per ascensori del 2/2	10104929021	26/01/17	27/01/17	1	0	SI	SI	€	140,00	€	140,00	FEBBRAIO	IN ATTESA	
94	Assistenza sala macchine per ascensori del 1/2	10104929014	26/01/17	31/01/17	1	0	SI	SI	€	850,28	€	850,28	FEBBRAIO	IN ATTESA	
95	12 Boccioni Datta - Boffalini	10104929002	26/01/17	27/01/17	1	2	SI	SI	€	125,00	€	125,00	GENNAIO	SI	GENNAIO
96	Assistenza Piano Ricca 202	10104928999	26/01/17	26/01/17	1	1	SI	SI	€	46,86	€	46,86	FEBBRAIO	IN ATTESA	
97	Assistenza Piano Ricca 202	10104928977	26/01/17	26/01/17	1	1	SI	SI	€	46,86	€	46,86	FEBBRAIO	IN ATTESA	
98	Messa Dalmine - Controllo pesca kohab + Scrittura	10104928976	15/01/17	26/01/17	1	2	SI	SI	€	46,86	€	46,86	GENNAIO	IN ATTESA	
99	Assistenza sala macchine FTM per 2/2	10104928975	26/01/17	26/01/17	1	2	SI	SI	€	93,72	€	93,72	FEBBRAIO	IN ATTESA	
100	Assistenza sala macchine FTM per 2/2	10104928974	26/01/17	30/01/17	1	0	SI	SI	€	93,72	€	93,72	FEBBRAIO	IN ATTESA	
101	Le luci delle scale funzionano ad intermittenza	10104928958	26/01/17	27/01/17	1	1	SI	SI	€	92,60	€	92,60	FEBBRAIO	IN ATTESA	
102	Le luci delle scale funzionano ad intermittenza	10104928958	26/01/17	26/01/17	1	2	SI	SI	€	92,60	€	92,60	FEBBRAIO	IN ATTESA	
103	Le luci delle scale funzionano ad intermittenza	10104928957	26/01/17	26/01/17	1	2	SI	SI	€	92,60	€	92,60	GENNAIO	IN ATTESA	
104	Assistenza sala macchine FTM per 2/2	10104928955	26/01/17	26/01/17	1	2	SI	SI	€	46,86	€	46,86	GENNAIO	IN ATTESA	
105	Capelli M. n.2 soffiate doccia + pedane + termostato	10104928954	26/01/17	26/01/17	1	1	SI	SI	€	46,86	€	46,86	GENNAIO	IN ATTESA	
106	Assistenza sala macchine FTM per 2/2	10104928950	26/01/17	30/01/17	1	2	SI	SI	€	93,72	€	93,72	FEBBRAIO	IN ATTESA	
107	Assistenza sala macchine FTM per 2/2	10104928948	26/01/17	25/01/17	1	1	SI	SI	€	23,43	€	23,43	GENNAIO	SI	GENNAIO
108	Assistenza sala macchine FTM per 2/2	10104928946	26/01/17	26/01/17	1	2	SI	SI	€	46,86	€	46,86	FEBBRAIO	IN ATTESA	
109	Assistenza sala macchine FTM per 2/2	10104928945	26/01/17	31/01/17	1	22	SI	SI	€	452,38	€	452,38	FEBBRAIO	IN ATTESA	
110	Boccioni Sabbio	10104928976	26/01/17	25/01/17	1	1	SI	SI	€	85,00	€	85,00	GENNAIO	IN ATTESA	
111	Boccioni Datta	10104928974	26/01/17	25/01/17	1	1	SI	SI	€	95,00	€	95,00	GENNAIO	SI	GENNAIO
112	Boccioni per Canoni	10104928973	26/01/17	24/01/17	1	0	SI	SI	€	105,00	€	105,00	GENNAIO	SI	GENNAIO
113	Boccioni Boffalini	10104928972	26/01/17	25/01/17	1	1	SI	SI	€	55,00	€	55,00	GENNAIO	SI	GENNAIO
114	Boccioni Datta - Boffalini	10104928971	26/01/17	25/01/17	1	1	SI	SI	€	162,42	€	162,42	GENNAIO	IN ATTESA	
115	Boccioni Datta - Boffalini	10104928970	26/01/17	25/01/17	1	1	SI	SI	€	70,00	€	70,00	GENNAIO	IN ATTESA	Mancano 4 ore
116	Boccioni Datta - Boffalini	10104928969	26/01/17	16/02/17	1	7	SI	SI	€	46,86	€	46,86	GENNAIO	IN ATTESA	
117	Boccioni Datta - Boffalini	10104928968	26/01/17	26/01/17	1	2	SI	SI	€	46,86	€	46,86	FEBBRAIO	IN ATTESA	
118	Boccioni Datta - Boffalini	10104928968	26/01/17	27/01/17	1	4	SI	SI	€	47,80	€	47,80	FEBBRAIO	IN ATTESA	
119	Assistenza sala macchine FTM per 2/2	10104928967	26/01/17	26/01/17	1	1	SI	SI	€	46,86	€	46,86	GENNAIO	IN ATTESA	
120	Assistenza sala macchine FTM per 2/2	10104928966	26/01/17	23/01/17	1	4	SI	SI	€	206,38	€	206,38	GENNAIO	SI	GENNAIO
121	Assistenza sala macchine FTM per 2/2	10104928965	26/01/17	20/01/17	1	1	SI	SI	€	150,52	€	150,52	GENNAIO	SI	GENNAIO
122	Assistenza sala macchine FTM per 2/2	10104928964	26/01/17	26/01/17	1	1	SI	SI	€	55,00	€	55,00	GENNAIO	SI	GENNAIO
123	Boccioni Datta - Boffalini	10104928963	26/01/17	24/01/17	1	1	SI	SI	€	46,86	€	46,86	GENNAIO	SI	GENNAIO

Fig. 27 - Screenshot of the accounting support tool; the different colors of the rows define the accounting status of the work order, the information in the spreadsheet are taken from the informative system (source: Supplier)



In the previous image [Fig.27] there's a screenshot of the tool: the first-row displays the names of the columns with filtering options (from left to right): a brief description or title, the serial number, date of creation and of execution, month of creation, reaction time, executed (Y/N), costs declared (Y/N), workforce price, materials price, total price, month when the cost is declared to the client, certification status, certification month, notes.

All the following rows of the file represent a received work orders, that is inserted, either when received on the ERP's user interface or when executed by the operator, by the assistant contract manager; the information for the insertion of a new row are gathered by the ERP's user interface and by the work report that is filled by the technician at the end of the execution. The spreadsheet had a color code that give quick and direct information of the accounting status of the work orders:

White = costs not yet declared to the Client through the user interface of the ERP

Blue = the work is executed and the costs have been declared on the user interface of the ERP

Red = on fee activity, the order is closed and no costs have been charged on the ERP

Green = the activity has been certified on the ERP

#### IV. Indicators

To better manage the information that are gathered in the tool the Supplier structured it to calculate the monthly account receivable and some basics indicators to monitor the performance of the workshop both economically and operatively.

##### *Number of requests*

The first indicator that could be useful for the Supplier is a calculation of the number of orders issued in the month, this indicator was useful to trace the usage of the user’s interface by the Client.

The following list [Tab.12] comprehends all the work orders that have been traced on the tool that may be on-fee or extra-fee activities. They are ordered by month of creation of the order (starting from the introduction of the informative system in April 2016) and catalogued by the state of execution:

yes = executed and concluded;

no = still pending;

empty = no information available, the request might be still not executed or planned.

<i>Number of orders</i>	EXECUTED (yes / no / empty)			13/feb/2017
<b>Month of creation</b>	<b>no</b>	<b>yes</b>	<b>empty</b>	<b>total</b>
<b>4 – April</b>		1		1
<b>5 - May</b>		4		4
<b>6 - June</b>		1		1
<b>7 – July</b>		1		1
<b>8 – August</b>		1		1
<b>9 – September</b>		19	1	20
<b>10 – October</b>		180	5	185
<b>11 – November</b>	1	164	7	172
<b>12 – December</b>		96	5	101
<b>1 – January</b>		116	23	139
<b>2 - February*</b>		26	9	35
<b>total</b>	<b>1</b>	<b>609</b>	<b>50</b>	<b>660</b>

*Tab. 12 - Number of work orders managed with the accounting support tool in time [\* = partial data]  
(source: J. Carrara)*

This information is not strictly linked to the economic performance of the workshop, but shows important data on the number of requests that are managed by the informative system and the trend of usage.

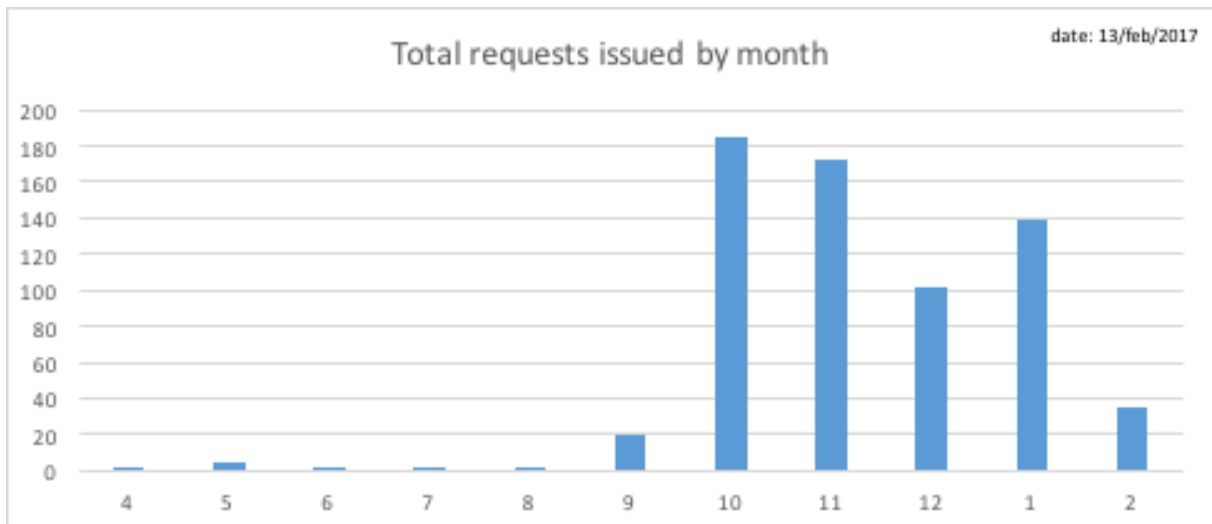


Fig. 28 – Chart that describes the trend of tab.12 (source: J. Carrara)

The above graph [Fig.28] shows the number of requests managed by the ERP through time; the information gathered before September 2016 must be considered biased due to the lack of information available and the fact that the tool was structured from that date, still they can be considered representative of the use of the ERP in the first months after the introduction.

The reduction of usage of the ERP after the peak in October, though February is to be considered partially, must be analysed and monitored by the parts; it may be the result a more efficient management of the workloads, an effective reduction of requests for intervention by the Client or it can be the result of an increase of untraced interventions, creation of cumulative work orders.

To better understand the numbers of the reduction of work orders it is interesting to check the amount of on-fee work orders that are managed through the ERP system. As explained in the previous chapters the procedure to request and execute on-fee activities may not require the issue of a work order through the ERP. This behavior often created issued with the traceability of the executed interventions and the following eventual cost declaration (if the work order revealed extra-fee).



Fig. 29 - Chart that describes the trend of the on-fee requests through time (source: J. Carrara)

The graph [Fig.29] shows the indicative number of on-fee work orders traced on the Supplier's accounting tool divided by month of issuance. Considering that all the requests processed on the Supplier's ERP user interface are on the Supplier's accounting tool these numbers can be considered for the ERP itself.

It is clearly shown a substantial decrease of orders issued between November and December and a low number of requests issued in January (and February). This numbers confirm the reduction of work order issuance from the Client towards the Supplier and is motivated by two different reasons:

1. The Client often did not create work orders for on-fee activities that are considered conduction of the systems such as: temperature regulations, clogged sinks or toilets, blown bulbs
2. Most of the on-fee activities that were detected by the Supplier are executed without keeping trace of the intervention and without noticing the Client.

*Charged cost control*

The second indicator generated is a strictly an accounting tool that lists all the declared costs of the work orders, to trace months, status, expected and paid receivables.

The information set in the first spreadsheet of the accountability file are managed and reassembled in months and certificate status, the Supplier can verify the pending costs and the certified costs divided by month of declaration and month of issuance of the order.

The actual accounting amounts are not shown in the following table [Tab.13] for privacy reasons, still we can see the reasoning of the indicator that highlights the pending receivables and the actual paid amounts divided by the month of issue of the order.

<i>RIEPILOGO – 13/feb/2017</i>	PENDING	PAID	Total
<b>Month of creation of the order</b>			
<b>5 - May</b>	<b>0,0%</b>	<b>100,0%</b>	<b>100,0%</b>
<b>6 - June</b>	<b>0,0%</b>	<b>100,0%</b>	<b>100,0%</b>
<b>7 - July</b>	<b>0,0%</b>	<b>100,0%</b>	<b>100,0%</b>
<b>8 - August</b>	<b>0,0%</b>	<b>100,0%</b>	<b>100,0%</b>
<b>9 - September</b>	<b>2,5%</b>	<b>97,5%</b>	<b>100,0%</b>
<b>10 - October</b>	<b>1,4%</b>	<b>98,6%</b>	<b>100,0%</b>
<b>11 - November</b>	<b>6,0%</b>	<b>94,0%</b>	<b>100,0%</b>
<b>12 - December</b>	<b>12,4%</b>	<b>87,6%</b>	<b>100,0%</b>
<b>1 - January</b>	<b>44,3%</b>	<b>55,7%</b>	<b>100,0%</b>
<b>2 - February*</b>	<b>100,0%</b>	<b>0,0%</b>	<b>100,0%</b>
<b>Total</b>	<b>8,9%</b>	<b>91,1%</b>	<b>100,0%</b>

*Tab. 13 - Accounts receivables verification table that identifies the PENDING costs that are waiting the certification and the PAID costs that already have been certified [\* = partial data] (source: J. Carrara)*

The trend of the received quantities is displayed in the next graph [Fig.30] that shows the decrease of revenue in the months of November, December and January previously seen in the first indicator. The month of October has been taken as benchmark.

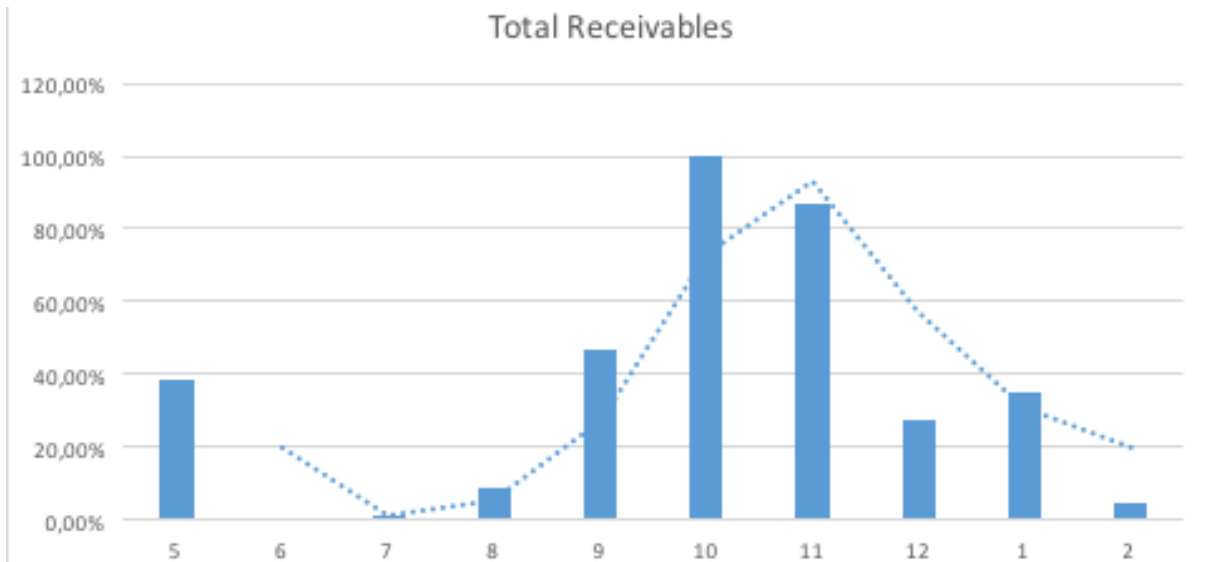


Fig. 30 - chart that compares the total received payments by months with the correspondent trend line; [10 = 100%, 2 = partial data] (source: J. Carrara)

This analysis does not fulfill the requests of the Supplier because it does not correctly express the performance of the extra-fee activities managed through the ERP user interface.

In the month of December, due to delays of payments and Client's budget issues, some consistent payments towards the Supplier for work orders that were issued on the ERP where managed through an external invoice outside of the informative system. This invoice comprehended work orders that were issued in the previous months but still are marked, improperly, as declared in December, falsifying the data.

Having cleaned the data from those accounts the following graph shows the correct indication of the economic trend of the ERP usage for extra-fee work orders.

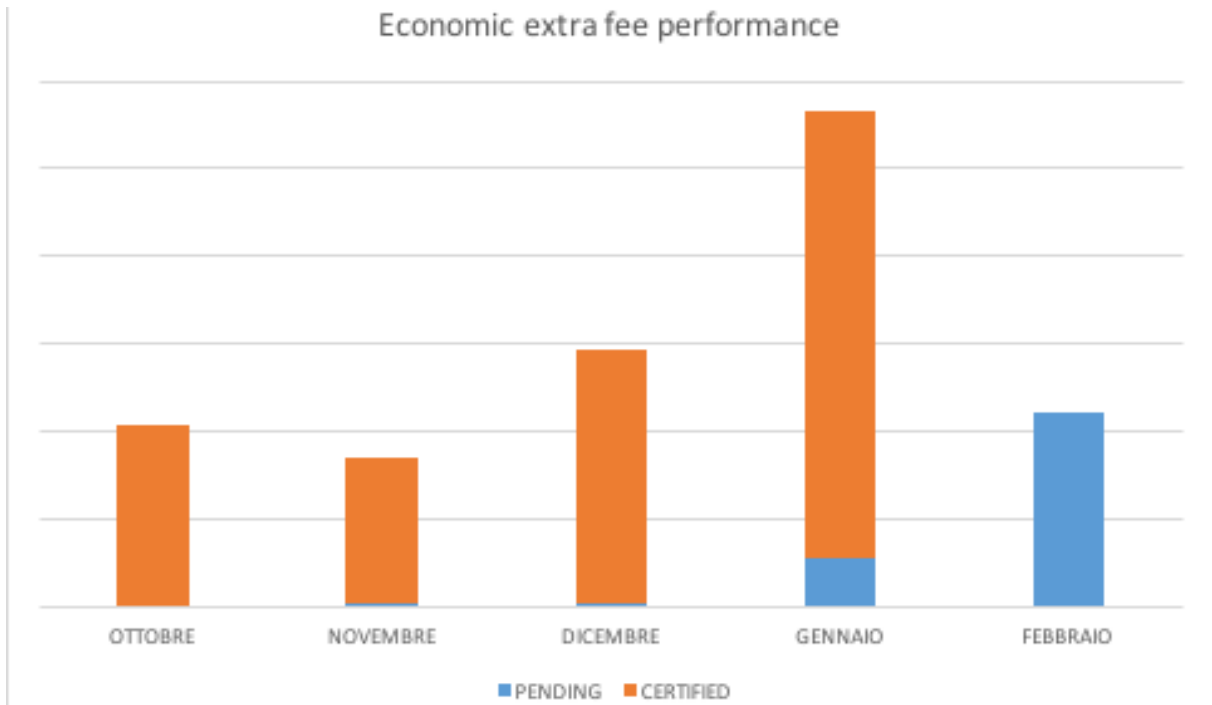


Fig. 31 - Chart of the received payments organized by the months, cleaned of the extra-system payments; the different colors define the status of the declared cost (source: J. Carrara)

The graph shows a consistent increase in certified costs, in **orange**, between November and January that indicates an increase of traceable transactions between Client and Supplier. The **blue** column shows the declared costs that are certification pending and, considering that February is considered only for its first 10 days, confirm the trend of increased usage of the ERP from the Client and Supplier.

### Reaction time

The insertion of the date of creation of the order and the date of execution allowed to calculate a rough reaction time of the Supplier’s workshop to the request issuance.

The reaction time is supposed to be intended as the time from the issuance of the order to the time of acceptance of the order, or to the start time of the order. Since these data were not easily traceable in the process, the spreadsheet was set up to calculate the difference from the date of issuance of the order to the date of conclusion; the name “reaction time” rather than “lead time” is used considering that the number of requests that require 1 or 2 days to be executed clearly outnumbers the requests that take longer.

With this in mind, the name “reaction time” is considered more appropriate.

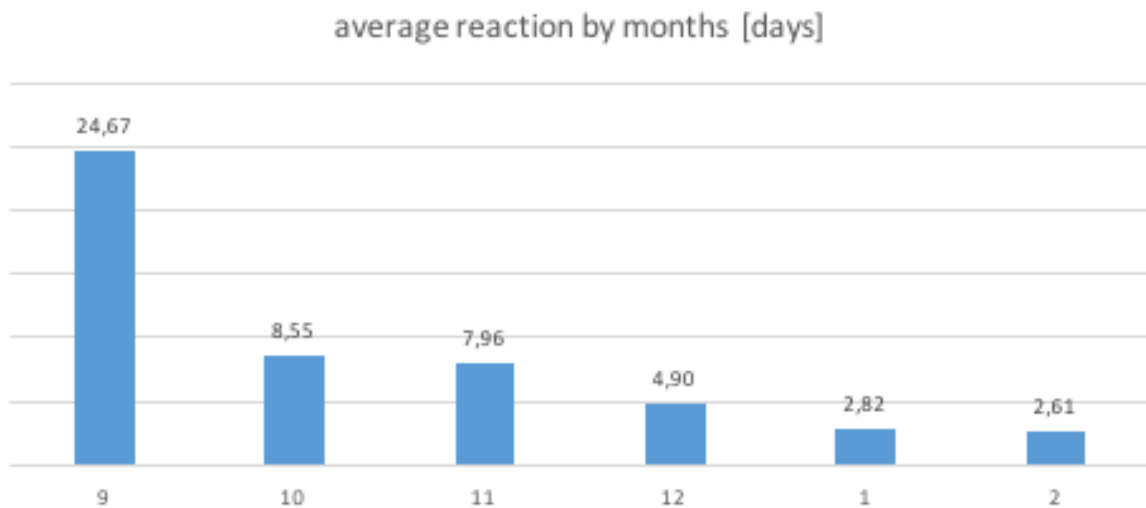


Fig. 32 - Reaction time, in days, divided by month; date: 13/feb/2017 [2= partial data] (source: J. Carrara)

This indicator is a straightforward indicator of the performance of the workshop and the governance on the management of the workload. Since the introduction of the new procedures and support tools (September - October) the reaction time to a request of the Supplier went decreasing continuously.



## 5. Possible improvements

The improvements already set up by the Supplier partially compensate the major issues that plagued the efficiency of the contract, the management of the resources and the flow on information. These improvements have not been structured along with the Client and respond only to the needs of the Supplier. The set of information that stems from the tools that the supplier introduced is not shared with the counterpart generating, obviously not in a mischievous way, a leak in the transparency requirements from the Supplier towards the Client. Moreover, the available data from the interventions is minimum; the possibility to extend the information available on the Client's real estate is highly recommended.

### I. Information system

The improvement of the information system can increase the efficiency of the maintenance activities, increase the information flowing in the system itself and reduce misunderstandings between the parts, Client and Supplier.

As proposed by the UNI 10604 an informative system for the management of real estate maintenance (SIGeM<sup>45</sup>) should be structured to

- Appropriately manage the diversity of the data regarding a real estate;
- Adapt according to the changing of the regulations;

And in any case a system should:

- Efficiently manage the maintenance plan;
- Issue documents that allow the activities;
- Gathering and processing the information regarding the maintenance executed.

Even the UNI 10951 chap.4.2 sets some basic requirements for the informative system (that are: manageability, data availability, updatability, integrability, consistency and safety) and the structure of an informative system for the SIGeM.

The SIGeM should be structured in registries and archives that contain all the data available of the real estate. These elements are managed through defined procedures that allow the processing of the data gathered.

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45 UNI 10951:2001; 3.2 "SISTEMA INFORMATIVO PER LA GESTIONE DELLA MANUTENZIONE DI PATRIMONI IMMOBILIARI (SIGeM): STRUMENTO DI SUPPORTO DECISIONALE ED OPERATIVO COSTITUITO DA BANCHE DATI, PROCEDURE E FUNZIONI FINALIZZATE A RACCOGLIERE, ARCHIVIARE, ELABORARE, UTILIZZARE ED AGGIORNARE LE INFORMAZIONI NECESSARIE PER L'IMPOSTAZIONE, L'ATTUAZIONE E LA GESTIONE DEL SERVIZIO DI MANUTENZIONE"

In the analysed study case the data on the real estate of the Client is full of gaps especially on technical and historical aspects. The information regarding all the executed activities, both maintenance plan and on-request maintenance, is gathered by the Supplier on papers that cannot be processed by a computerized system and would require an unaffordable effort of the office resources to process them analogically. The as is situation makes it nearly impossible to structure an effective archive or registry to implement in the SIGeM if not with an extraordinary expenditure of economic and working resources.

The proposed solution has the aim to create/updated the Client's building registry and allow the introduction in the information system of all the feedback information that are contained in a work order, as described in the previous 4.2 chapter. To reach these goals the idea is the creation of a new adapted computerized maintenance management system (CMMS) and a slow integration of the information once the activities are ongoing through a process of continuous update of the registries and archive based on the already existing location registry and a basic creation of a technical registry.

As shown in the following figure [Fig.33], the information flow that should enter the registry should come from all maintenance activities performed by the Supplier and even extra maintenance activities that the Client may execute out of the contract provided services. The data will be extracted from work reports or similar documents and inserted in the registry to create a work record and to update/create the registry itself. The registry has the possibility to be read by a processing engine that extracts more information regarding FM activities such as periodicity of intervention, sensible locations, etc.

These data, when inserted and gathered, should be managed by a competent figure that has knowledge of the registry structure to avoid incomplete or wrong insertions.

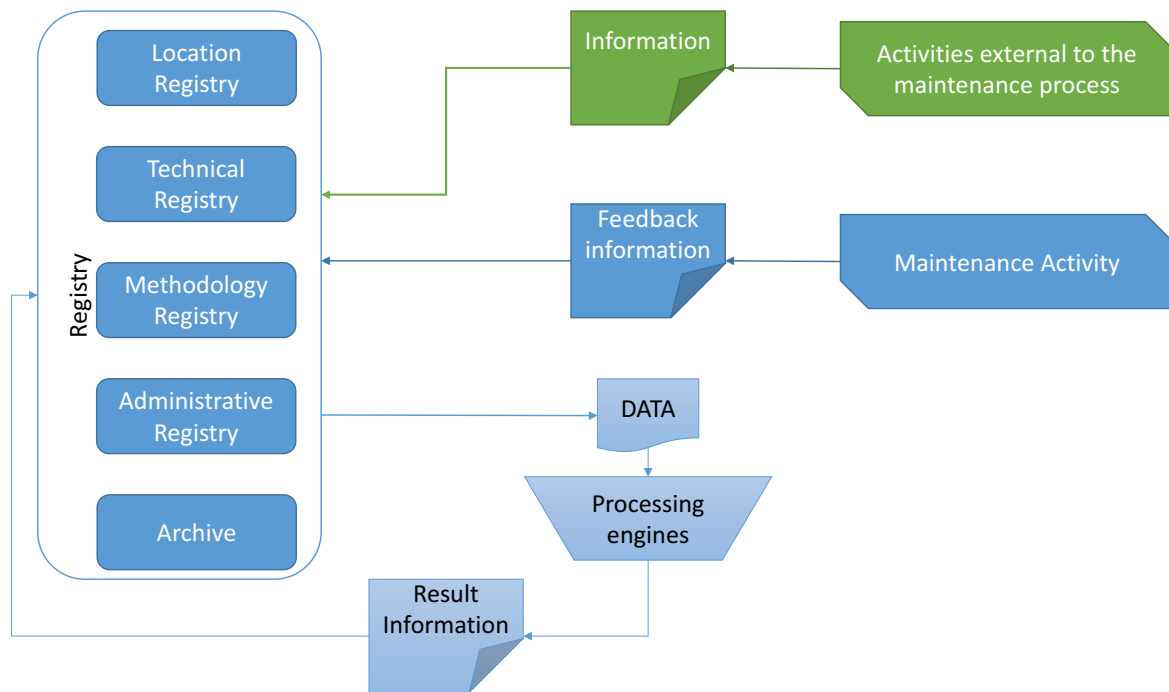


Fig. 33 - Information flow from the executed activities to the registry and data processing of the registry (source: J. Carrara)

To create a basic technical registry the Client can exploit the knowledge of the experienced personnel of the Supplier through technical reports and following the execution of the activities to increase the knowledge on its real estate technical aspects. The quest of creating the registry can be made internally by the Client, demanded to the Supplier or demanded to an external consultant supplier. The aim of the research should be the location and identification of electrical, sewage, HVAC systems as first, followed by the identification of the building components (doors, windows) for every building of the facility (or, if not necessary, for selected buildings).

The insertion of the information is made through the daily activities that are executed and can be done on both Supplier and Client side. [Fig.34]

For the Supplier; the technician drafts the work report through which the information is extracted, the operator inserts the information of the executed activities in the registry, if he finds that some information is missing from the registry, the operator proceeds to integrate them in the system, otherwise the intervention is only registered in the archive.

For the Client, a user signals a fault/problem; the information on the problem are processed by the Client that drafts the work order with the help of the information already in the registry; the work order is sent to the Supplier for the execution and registered on the registry, whether the Client finds new data on the building systems or building components he inserts them in the registry, otherwise the order is only registered in the archive.

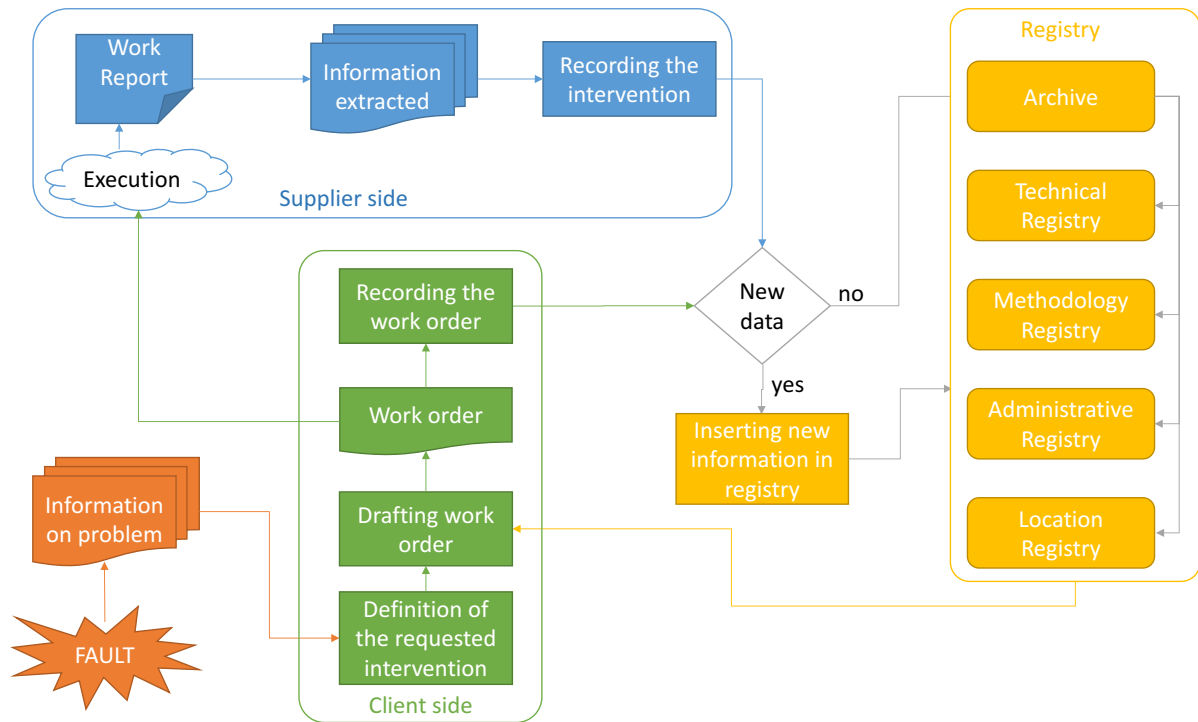


Fig. 34 - Registry construction/update process by the Client and Supplier (source: J. Carrara)

### Criticalities

The problems with the integration of this solution are different:

The informative system should be severely redesigned by the IT Client's technicians to be structured to accept the data that will be introduced. The existing registry should be re-examined to verify the information available and check the quality of them.

Secondly, this solution, once implemented, is thought to be managed entirely by the parts directly involved by the contract, Supplier and requesting authorities' personnel, which have the appropriate technical knowledge to manage and the access to the information.

The difficulties stem from the need of the involved resources to understand the SIGeM structure enough to efficiently enter new procedures, new technical elements and define methods in the system's registry.

It would be a revolutionary solution for the facility management activities for the Client and will allow the Supplier to eliminate a big amount of misunderstandings and wasted times due to information checks and interpretation.

## II. Planning

The more feasible improvement considers the fostering of the transparency policy and the sharing of the information between the parts as a crucial aspect of the relationship management. The goal would be to provide Client and Supplier of a proper planning procedure to manage the planning phase of the activities that can respect the needs of the Supplier of flexibility while giving the Client the sufficient transparency to supervise the status of the activities and all the ongoing planning process.

The requirements of the new planning procedure are:

- Transparency – the actions of the Supplier should be visible by the Client;
- Traceability – all the changes of planning should be visible, traced and highlighted; information on delays and deadlines should be accessible by both parts;
- Flexibility – the supplier should be able to change planning according to its needs; the planning dates should not be binding for the Supplier but only indicative till the actual start of the intervention.

The proposed ways to implement the solutions are two:

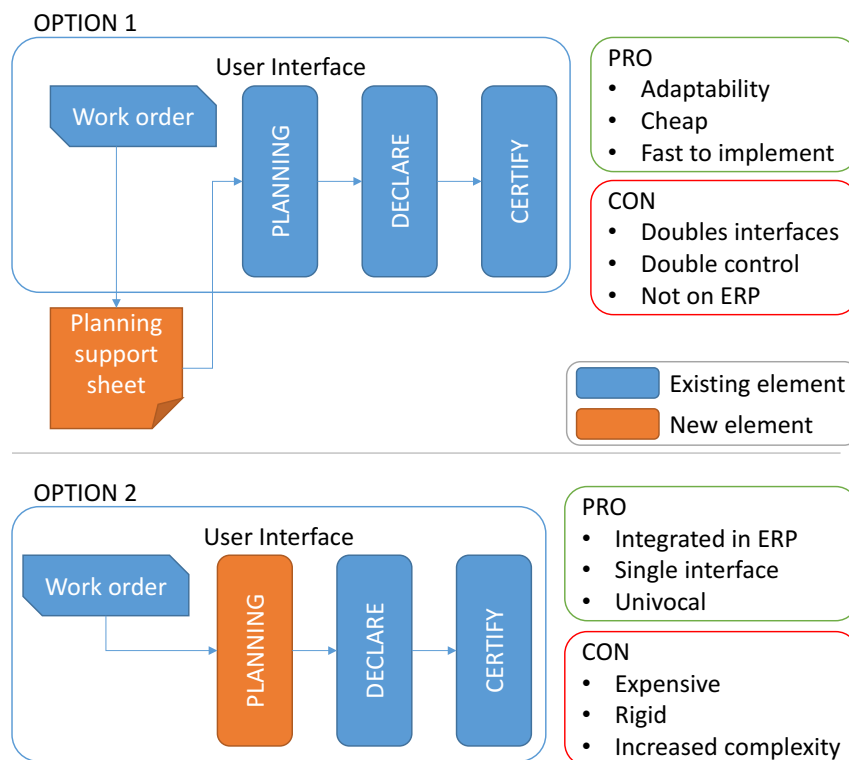


Fig. 35 - Planning procedure improvement options (source: J. Carrara)

### *Option 1*

Integrate a shared tool, in support of the existing ERP's user interface, for the sole purpose of the planning activities.

#### PRO

- I. Adaptability – the tool can be easily adapted to the requirements of the parts and the future possible changes; the tool can be easily removed or bypassed if needed;
- II. Cheap – The cost of the tool is generally zero (apart if external consultants are used); the costs to implement such tool can be calculated as the alternative cost of the time required to implement it and the time lost in learning to using it. The implementation of a spreadsheet tool, like the one already in use by the supplier, can be considered nearly at zero cost;
- III. Fast to structure – The creation of a spreadsheet or a generic support tool for the planning requires little design and implementation time.

#### CON

- I. Doubles interfaces – the Supplier will have to interact with two elements instead of one, this increase the possibility to make errors in the planning procedure or in the information management;
- II. Double control – the Client will have to monitor two different elements instead of one, this increases the confusion and the amount of time wasted controlling basically one single step of the procedure;
- III. Not on ERP – the tool will be implemented in the procedures but the information that rises from it will not be introduced on the Client's ERP. This is a major missing in the option since it limits enormously the information processing of the ERP.

### *Option 2*

Modify/substitute the existing user interface planning structure.

#### PRO

- I. Integrated in ERP – the modification of the existing structure of the user's interface will be connected to the Client's ERP and the new information gathered will be correctly processed by the system;
- II. Single interface – the Supplier continues to interact with one single interface, giving him a necessary uniqueness towards the processes.
- III. Univocal – Once the structure is set all the parties involved in the contract must adapt to the new standard procedure. A univocal standard procedure is a very important element for the increase of efficiency and the error detection in the processes.

#### CON

- I. Expensive – the implementation of this solution requires a mandatory intervention of the Client's IT unit. The required time to structure the solution may be long and requires audits and investigations by the Client;
- II. Rigid – the informative system, once defined, is not easily changeable. The definition of needs and the design of the procedure must be correctly done to limit the possibilities of corrections once the modification is implemented;
- III. Increased complexity – the modification of the user interface as is increases the complexity of the IT platform for the Supplier, giving new procedures, new elements, new data; this complexity increase is felt even on the Client's side because of the new data involved and the new data management that requires an appropriate training before the definitive adoption of the solution.

### *Final consideration*

On the light of transparency and efficiency it would be correct to adopt the second solution proposed, even if more expensive; the key aspect that makes Option 2 prevail and justifies the higher costs is the integration of the solution in the Client's ERP. The multiplication of the interfaces with which the parts interact must be limited to the least possible to manage the information only through one unique channel. The information flow will remain located in one place giving the ERP the possibilities to gather more data on the interventions and return more information that will help to increase the efficiency of the activities.

## 4. Conclusions

“At this point it should be noted that the Facility Management is not primarily a cost-cutting mode, but rather a complex process to define and control the quality of the non-core services, and, only where possible, achieve cost savings”.<sup>46</sup>

Starting from a description of the tender and its structure, through an analysis of both the official procedures described in the contract and the adapted procedures in use, ending with a focus on the information management and accounting this document has the aim to highlight the criticalities in a FM agreement in a manufacturing industrial facility.

The main conclusion is that the whole agreement, though performing well on the technical interventions, has many criticalities on non-operative aspects that reduce the impact of the long terms value adding aspects of an outsourcing agreement (improve knowledge of the real estate, strategical support on the FM, improve the procedures to increase efficiency).

The customer, in the client-supplier relationship, as always been considered as the dominant figure while the supplier may be considered as subordinate to the customer’s will. In an outsourcing agreement (such as the analysed case study), due to the long term of the agreement and therefore the need for collaboration between the parts, such an approach does not fit perfectly for the stakeholders. The supplier should be considered an important partner in the agreement and therefore its needs should be protected even by the client itself, through a self-monitoring process and a clear definition of the procedures and processes that rule the relationship technically, economically and generally on information management.

This was the light under which the case study was analysed and the proposals for the improvement were drafted.

### *Case study analysis*

The description of the tender highlights a complicated situation to manage for the parts brought by the dimensions of the facilities, the multitude of services provided by the supplier and the different stakeholders involved in the agreement and their multiple competences.

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46 TRONCONI O., CIARAMELLA A. – FACILITY MANAGEMENT; PROGETTARE, MISURARE, GESTIRE E REMUNERARE I SERVIZI – MILAN, FRANCOANGELI, 2014; CHAP. 5.2, P.84



The tender requires a clear structure of command center that must govern on strategical aspects and monitor the contracted activities; this command center should consist in all strategical internal stakeholders of the contract, the requesting authorities, and the supplier, because he should be considered in all strategical decision-making processes of the contract.

### *Procedures*

The procedures described in chapter 2-Procedures show how the structure of the relationship instructed by the contract did not fit the requirements of the stakeholders, bringing them to define unofficial, adapted procedures to solve the gap. This situation has brought to a complicated set of procedures for the supplier to manage, a loss of economic and technical efficiency in the maintenance process and competence interference between the internal stakeholders of the client and between external contractors working for the client. The solutions are found in the procedures that rule of the relationship:

- All the procedures defined should be officially written in the contract/tender to grant their application;
- The Client should define SLs and KPIs that comply with his request and are able to effectively monitor all the activities, in respect of the performance-based agreement that is the global service agreement;
- To correctly justify the adoption of penalties and/or bonuses the Client should monitor its own performance in accordance to SLs and KPIs as he does with the Supplier. This system is not intended to decrease the leading role of the client in the relationship but to generate structured measures that increase the Clients authority in monitoring the performance of the contract and raise the overall performance of the contract.

### *Information system*

All the activities are managed through an information system that, through the accounting process, it has been analysed in the last chapter.

The analysis showed that the information system is mainly relegated for a rough planning and cost declaration, without exploiting all the knowledge incrementing possibilities that could be managed with it. The Supplier had to adapt introducing tools and internal procedures to manage some of the information stemming from the interventions, expressing his discomfort towards the informative system; this provided a major improvement in his knowledge on the activities but the increased knowledge is not shared with the Client creating a disequilibrium in the relationship.

To improve the process the informative system should be provided with an appropriate record of the interventions and a structured registry that should be maintained and updated by both the Client and the Supplier.

The parts should team up to develop a new planning procedure that meets the needs of the Supplier, encouraging him to plan appropriately, and of the Client, that requires a more realistic planning of the activities. The two solutions proposed aim to the same goal but differ on the integration with the client's ERP that could increase the overall complexity of the information management but, on the other side, could provide more useful information for the parts.

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