Action Research on Process Analysis Maps. What does an arrow mean?

Paola Mauri

Senior consultant in System Management ICMCI Certified Management Consultant
Star s.r.l. – Via Piave 22060 Cabiate- Italy

`mauripaola5@gmail.com`

Abstract. I use an action research approach to present my projects, devoted to analyzing and describing processes in large sized companies. The cycle of interactions between theory and practice, proposed by action research, is described by means of the Checkland model and its elements. I shortly present the methodologies exploited in the projects, their main characteristics and results. In particular the different taxonomies and notations used during the process analysis are described. The topics of map sharing among different functions, formal/informal use of notation, meaning of the graphical symbols (for instance arrows) are posed as reflection and research themes.

Keywords: Process Analysis, Socio-technical Design, Mapping, Action Research

1 Introduction

In this paper, as suggested by E. Mumford [1], I present my practitioner experiences, using as a guideline an action research approach. In fact, my practice in not exactly an action research because my contractual requirements are not on research. But structuring retrospectively my expertise, clustering events and reflecting on my experiences I share several features of this approach.

In particular, as described in [2]: 'The ideal domain of the action research method is therefore revealed in three distinctive characteristics of the method. The researcher is actively involved…The knowledge obtained can be immediately applied…. The research is a cyclical process linking theory and practice'.

In Section 2 I briefly describe this approach, using the framework proposed in [2] and considering the action research as 'a cycle of continuous inquiry where theory interacts with practice'. Among the proposed models I apply the Checkland cycle [3] to describe my experiences. Accordingly, the sections of this paper are structured following the elements of Checkland model.

Section 3 summarizes the methodological framework that drive my practice: the development of management systems in accordance with ISO 9001: 2015 "Quality Management Systems - Requirements" [4] and in particular the requirements related to process analysis. My methodology is based on the socio-technical design, proposed in [1], focusing on an ethnographic approach, described in [5]. The mapping, I presented in a previous paper [6], is a key point in this paper, as well.

The experiences, described in Section 4, are the real world situations. They are a cluster of projects. Some projects have been running from several years others started recently. All of them are in large sized companies. Among the features of the projects, in this paper the focus is on the taxonomies and the notations used to develop process analysis. Examples are presented and the main results of the projects are shortly summarized.

Section 5 and 6 present the key points of an action research approach: the reflection on my projects and the proposal of research themes. The reflections confirm the effectiveness of maps in supporting a socio-technical design and open two questions related to the informal-formal use of notations and of the meaning of graphical symbols, in particular of arrows. Accordingly research themes are proposed: the definition of a multifocal mapping toolset for the socio-technical design, the analysis of the meaning of the notations from the social and the technical perspective and the exploration of new mapping approaches.

2   Action research

As stated by E. Mumford 'The story of socio-technical design is closely allied with action research' [1]. Then, in this paper, I assume as a reference the action research approach. The paper of R. Baskerville and A. Trevor Wood-Harper [2] is an overview on action research. In particular I apply the Checkland model of the cycle of action research described in Figure 1 [3].
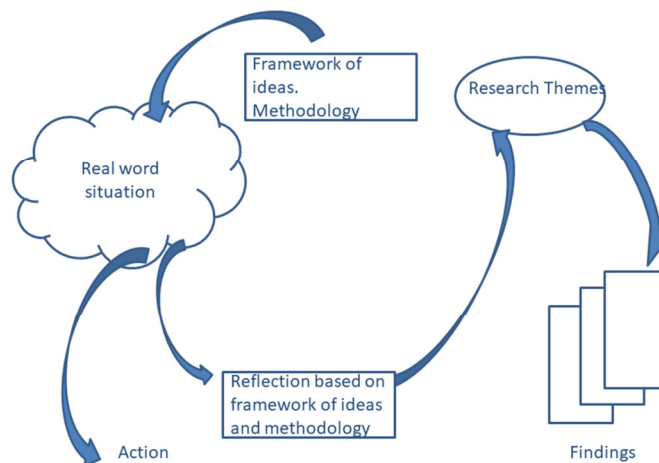
Fig. 1. Action Research. The Checkland Model

The key words of the Checkland model are:

- Framework of ideas. Methodology.
- Real word situation. Action
- Reflection based on Framework and Methodology
- Research themes
- Findings

These keywords are used in the section titles.

3   Framework of ideas. Methodology

I shortly summarize my methodological toolkit, described in [6]. From an action re-search point of view, these topics are my framework of ideas.

ISO Management Systems. The criteria that drive my practitioner activities are based on the business models proposed by ISO standards on management systems, including the analysis of context and risks.

Process Analysis. Since 2000, the Standard ISO 9001 on Quality Management System has prescribed a process approach. I must therefore use process analysis for "understanding and managing interrelated processes as a system" [4].

Socio-technical Design. In the socio-technical Design I have identified several similarities with the concerns of my practitioner activities: the idea that "technical structure and work roles are both part of an inclusive system" [1], the attention on the environment and on the adaptive systems, the social support designed to reinforce social behavior, the incompletion of the design, conceived as an iterative process.

Ethnographic Approach. The ethnographic approach, described in [5], posed me interesting questions. "The way the ethnographer is introduced in the field, the way she talks and she behaves have a significant effect on her relationship towards the people in the field and the data the ethnographer will be able to have access to."[5].

Mapping. My activities are backed up by several types of graphical tools: maps are always used to perform field observation of large sized companies. The maps are useful for exploring, for describing and defining relationships (organizational charts and processes), and for tracking and modifying behavior.

Among these topics, in the experiences presented in this paper I applied: Process Analysis, Socio-technical design and Mapping.

4   Real word situation. Process Analysis

Process Analysis is a key requirement of ISO 9001:2015, exploited in all my projects as part of the development of a quality management system. ISO defines a process as a 'set of interrelated or interacting activities that use inputs to deliver an intended

result. Whether the intended result of a process is called output, product or service depends on the context of the reference' [7]. The key elements of a process are: sources of input, input, activity, output, receivers of output [4].

The cluster of experiences I present is in four large sized companies. I do not describe a specific case, but a synthesis of all these experiences is proposed, focusing on mapping and notation.

4.1   Characteristics of the Large Sized Organizations

The large sized companies I worked with share several common features that are described in [5] and summarized in the following.

- The ownership is based on shareholders and the governance on board of directors.
- The distribution of sites and markets is worldwide and my practice is mainly with operation sites.
- The organizational structures are complex and often subject to changes through corporate projects that redesign the management approach and re-define 'process ownership'
- The complexity and the frequent changes of the organization make it difficult, even for the employees, to understand their 'positions in the field'.
- My contractual interfaces in the companies were Integrated Management Systems (IMS) functions.
- IT functions are far from my point of observation. My interfaces are often end-users or local functions and are not involved in the strategic development of new applications.

4.2   Projects and Actions

The main and common features of the described projects are listed in the following.

- The objective of all these projects is producing a set of maps that describe, at least, the processes that manage the customer relationships from offer and order management to delivering and customer servicing. The description of these core processes could be enlarged, if possible, to other processes, for instance measurement and monitoring, human resources management, continuous improvement, etc..
- As described in [6], with a Socio-technical perspective, I tried to develop my consultant activity through the involvement of all the functions that could contribute to the commitment of the design and implementation of management system. This involvement was based on interviews, meetings and workshops.
- The tools analyzed and/or used to map the processes could be commercial graphical tools or more structured tools that help in drawing processes using standard notations and constructing links with document and data repositories.
- In the projects, I had no direct relationship with the software business analysts and so the project results have no direct effect on the software applications, even if I exploit the same notation.

4.3 Taxonomies and Maps

During the projects the processes have to be suitably identified and classified and then a key point was how to define and to describe the processes, focusing on the topics related to taxonomies and maps.

To define the processes I deal with several scenarios. In some cases I worked with a roughly structured list of process names, just generic descriptions, such as production, customer order handling, delivery, etc. considering also taxonomies of other functional areas. For instance the controlling function defines customer order handling as 'order to cash' and the supplier order handling as 'purchase to pay'.

In other cases I had to analyze more structured taxonomies, as described in the following.

- The list of processes required by Railway ISO/TS 22163:2017 'Railway Applications-Quality management system' [8]. For instance Project Management, Configuration management, Obsolescence management, etc..
- The list of more than one thousand processes coded by APQC [9] and layered with four levels of detail. The levels are: Category, Process Group, Process, Activity, Tasks. The first level is clustered in two main categories: Operating processes (develop vision and strategy, develop and manage product and services, market and sell product and services, etc.) and Management and support processes (develop and manage human capital, acquire, construct and manage assets, etc.).
- The processes embedded in information systems, such as customer order handling in ERP (Enterprise Resource Planning) software.

To describe the processes, the inventory of the map toolkit includes descriptive tools and graphical tools. Some of them are sketched in Figure 2 and described in the following.

- Tables where the column define process (name and description), input, output or, in a more structured way, SIPOC (Supplier, Input, Process, Output, Customer) descriptions. SIPOC is proposed by Six- sigma management approach [10].
- Turtle chart, where the process description is related to input, output, ownership, KPI (Key Performance Indicators), risks, etc. This representation is highly recommended by the automotive and railway markets.
- Flow-charts based on standard notation such as BPMN [11] or IDEF0 [12]. BPMN is the base of several commercial tools used in organizations.
- Hybrid notations, i.e. a mix of graphical symbols with no reference to standards.

These maps could be linked to process owners, documents, KPIs, Risk analysis, etc. and could change: for instance if the business model changes the process ownership could change with the model.
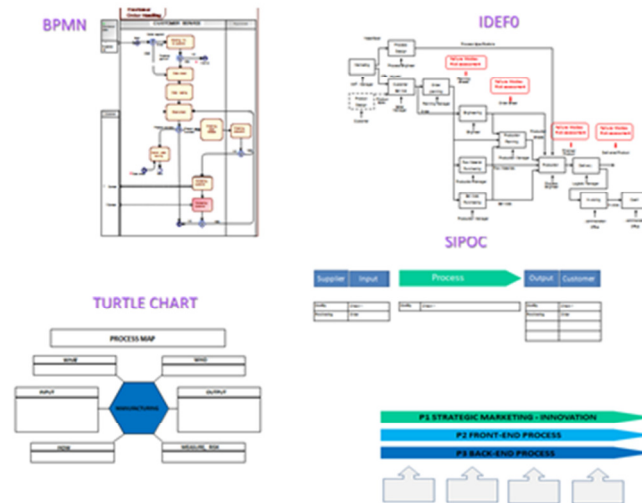
Fig. 2. Process maps

4.4   Examples

I present a synthesis of the process mapping I developed in the cluster of experiences.

As described before, to develop a quality management system, I have to map, at least, the processes that manage the customer relationships from offer and order management to delivering and customer servicing. These processes are linked with the ISO requirement '8. Operation' that describes the 'Customer related processes'.

If I have non constraints in using the notation (for instance Turtle Chart), I prefer using, in an informal way, the IDEF0 notation and producing high level maps as in figure 3. These maps are a result of my practice and of my contractual commitment. They are part of the documented information that describes the quality management system and I use them, for instance, as a guideline when performing ISO 9001 internal audit. The focus of this map is how customer requirements are deployed in the operational processes.

Applying a socio-technical design, I define this kind of map through meetings and interviews with the owners of the processes. For instance I meet the Sales Manager to describe the customer service, the Production Manager to describe the production planning, the Process Engineer to describe the production, and so on. In this way I define the 'set of interrelated or interacting activities' and I could describe every box of the map, in more detail. I exemplify this approach considering my experience in mapping the processes of Customer Service and Order Handling.
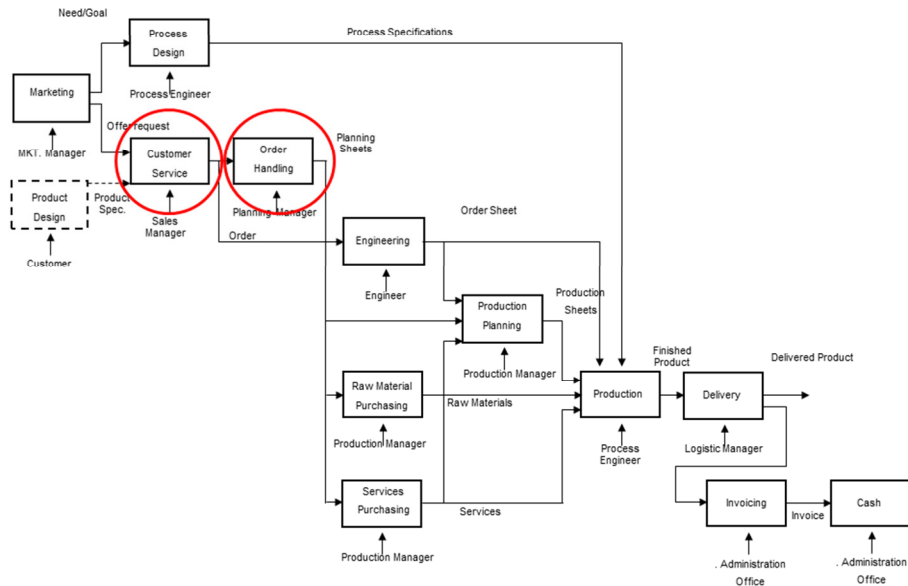
Fig. 3. Customer related processes

During the meetings on 'Customer service', the Sales Manager presented a set of maps that describe the processes of the Sales Department and, among them, a map on 'Customer order handling' as in figure 4. The processes are described focusing on the relationships with the customer and mapped with the cooperation of the IT ERP System Manager, using a BPMN. The flows have been referenced in the procedures prepared by the IT department for training of employees on the new ERP. The same flows, probably, have been used to develop the ERP, but I have not had the opportunity to meet the development team and/or to analyze their maps.

During the same meetings I discovered that the same process of 'Customer Order handling' was described, by the Administration and Controlling Function as 'Order handling', using a 'free' notation as in figure 5. In this case, the process is described focusing on financial topics, such as credit check. The Information Systems were involved as 'recording tools' (repositories, forms, data base). These process descriptions are usually on the basis of the internal audit of the controlling functions.

Then the same process of (Customer) Order Handling is described focusing on operation for the quality management system, on customer and ERP for Sales and IT and on shareholders for Controlling. The same process is described with three different notations.
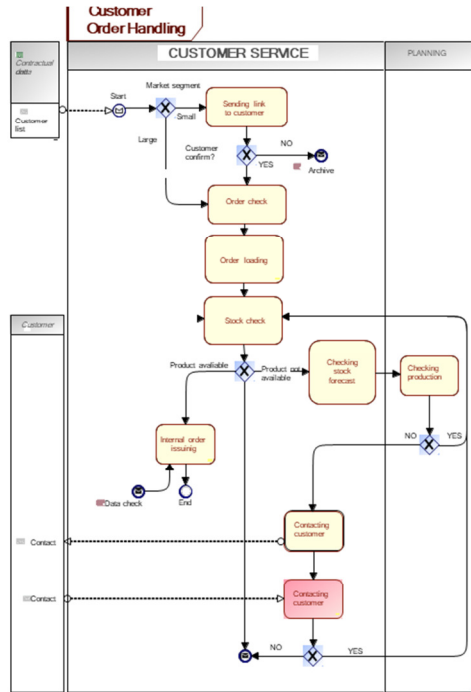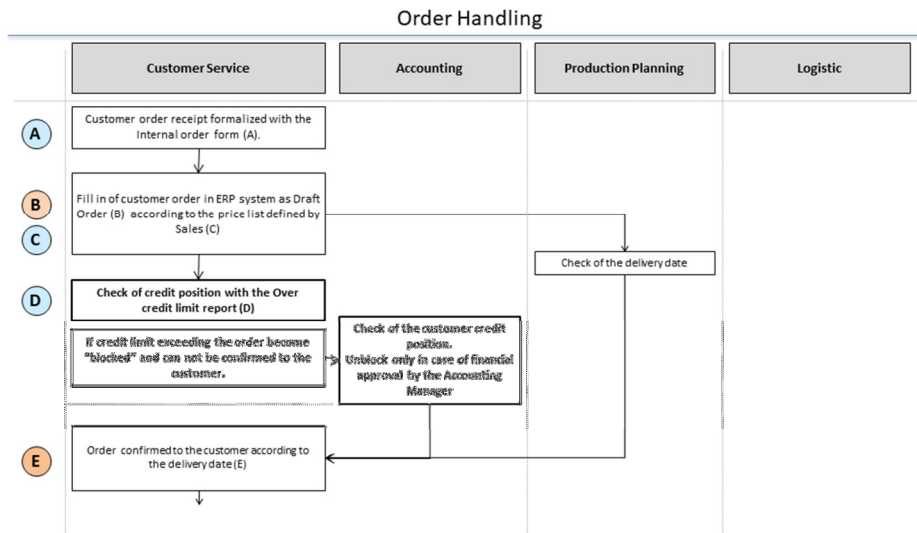
Fig. 4. Customer order handling

Fig. 5. Order handling

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4.5 Results

The projects confirmed my belief that the analysis of the processes with a social approach is a useful way for involvement, empowerment and change of behavior. I described these positive results in [5]. In recent projects, my social approach was improved through a more structured project development. For instance the plan of meetings and interviews was built through the initial involvement of top managers and the analysis was deployed with 'process deputies' of the functional area.

The maps supported all the projects steps, acting as an effective way of communication and becoming one of the main deliverables of the projects: the framework that supports the Integrated System Management.

As means of communication they have been initially used by the project team without stressing a rigorous use of the notation. But as deliverables of the project, required as documented information of the management system, the choice and meaning of the notation became a key point of discussion in the team. In the presented experiences, only one organization describes all the processes with the same notation (BPMN).

The relationships with the other functions that exploit process analysis had different results. For instance, in some projects, the gap with Controlling functions was reduced sharing common maps to describe processes related to customer and supplier management. The weak point was still in defining link with the technical side, i.e. the IT functions and their approach in business process analysis, even if the project teams deal with the same processes and share the same notation. In [6] I described my failure in developing a common project between management system and information system and pointed out that the socio-technical design 'shows some weaknesses that could be related to the lack of a defined and strong identity, easily recognized in the market scenario….. In these cases, the 'traditional' approach for the IT analyst is evaluated by the company as more effective and then less expensive'.

5 Reflections

I present, as described in section 2, some points of reflection, related to Process Analysis, Socio-technical Design and Mapping, that rose up during my projects.

5.1 Any type of graph is better than a table

The recent projects reinforced my hypothesis that 'maps could be conceived as windows for viewing the world and as artefacts to modify the world' [5].

The enlarged inventory of taxonomies and notations confirms the role of maps to communicate. Most of the company presentations I analyzed in the projects are based on maps. Inside the organizations, even the color and the shape of symbols could be a reference.

5.2   Drilling down in the processes

For communication even a naïve graph is effective. But if want to move in a more structured direction the trend is from informal to formal interpretation of taxonomies and graphical symbols.

I exemplify, using APQC taxonomy that describes these main categories of Operating processes.

    1.0   Develop Vision and Strategy
    2.0   Develop and Manage Products and Services
    3.0   Market and Sell Products and Services
    4.0   Deliver Physical Products
    5.0   Deliver Services
    6.0   Manage Customer Service

In all these categories part of the processes could be performed using Information Systems. For instance in '3.0 Market and Sell Products and Services' the activities of '3.5.4 Manage Sales Order' – '3.5.4.5 Enter orders into systems' are usually supported by an ERP. But '2.0 Develop and Manage Products and Services' is usually performed with several different information systems (including social media) or without them.

In my projects the business process maps connected these layers considering the information systems as tools or data repositories. Probably, the same business processes had been described, from a different point of view, to develop the information systems. In some experiences the BPMN was used to describe the same processes from the two perspective but the process maps, as far as I know, had no relationships.

In any case, my efforts continue to be in connecting these different 'point of view' and these different layers of the organizations, for instance including IT function in meeting and interview.

5.3   Meaning of the graphical symbols

In mapping the processes, moving towards a better definition of graphical symbols, I often reflected on their meaning.

- **Boxes**, and more generally polygon, mostly always describe an activity, including as a particular type of activity, the choice.
- **Different symbols** (box or text) describe the ownership of processes and activities.
- **Arrows** describe different types of relationships:
    - informal relationship with sequence and interactions, suggesting a goal to reach
    - main relationship with input/output (SIPOC and IDEF0) and secondary with time
    - main relationship with time (BPMN) and secondary with input/output

Then, with different meanings, arrows are linked to time direction (before/after) and to entities.

Furthermore, during my projects, I often argued why processes are usually represented through boxes and arrows and why in the 'network era' this 'deterministic' approach is still prevalent.

6　　　Research Themes. (Findings)

Considering the reflections previously described, I pose these research themes, presently without any structured findings.

6.1　　Linking the maps

The process analysis could be developed in different functional areas of the organizations. In my experiences, these areas often describe the process with similar notations but without sharing any type of information. In a socio-technical perspective, a multi-focal approach (researcher, practitioner and organization) have to explore the possibility of a common background, with different layers for a socio-technical design, sharing methodological tools and developing a mapping toolset, moving from a less formal to a more formal use of notation.

6.2　　Reflecting on the graphical symbols

In a recent paper on business process models [13] the authors reflected on graphical symbols and on their meaning 'to make explicit the nature of links holding amongst activities'. Different forms of Occurrence Dependence are presented: Historical Dependence, Causal Dependence and Goal-based Co-occurrence, stating that '…although many efforts have been carried on so far in order to characterize ordering relationships between business process activities, an ontological analysis of these dependences has not been proposed yet'. The paper describes two Application Scenarios on business process documentation and on business process redesign.

Then the question 'Is there anything beyond arrows?' posed in the title, suggests me the answer '…so many things beyond arrows' or, better, so many meanings of the arrows.

Let's consider for instance the historical dependence, where 'one can perform an activity on an artefact only if this artefact exists and is available'. The paper [13] describes this dependence with login/logout and makes diagnosis-proposed treatment.

I consider as an example of the historical dependence, the supply chain process of delivering a product that requires the sequence: handling the customer order, producing or buying the product and delivering. This dependence could be monitored if all the events are tracked on the same medium, for instance an ERP. The complexity in describing this dependence increases if the media are several or none, for instance if the data for managing customer relationships are on a file system and the activities of driving a truck are not recorded.

If the use of process maps could be a bridge between the social and the technical side, researchers and practitioners have to focus on the notations that support them, considering structured approaches but also modifying their mindset and exploring other graphical tools.

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