A METHODOLOGY FOR INITIAL SYSTEMS ANALYSIS USING CONSTELLATION DIAGRAMS

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ABSTRACT

Information systems projects, as well as most general business process improvement projects, require analysts to gather vital information pertaining to all applicable business processes as early as the first meeting or interview with prospective clients. It is also essential for the analyst to give useful feedback to the client as soon as possible after that first meeting so that the client understands that they have been heard in a meaningful way and that activity has actually begun on their project [Gause & Weinberg, 1990]. However, during the initial interview analysts often have difficulties in gathering and recording useful information about the business and do not gain an accurate picture of either the current status or where the business would like to go. Clients in turn often wonder why they have given up their valuable time and may be less willing to contribute fully to the analysis process since they are not convinced that a meaningful result will ensue. The constellation diagram process described here gives the client "next day" feed back with an initial IS model of the organization. The methodology is transferable; it has been successfully taught to approximately 250 of upper level Computer Science and Business undergraduate university students as a part of a systems analysis course or course module. The methodology is also practical; some business franchise systems have used the model that was created for them in this phase of the system's analysis to describe the organization to prospective franchisees, which indicates the value of the information gathered, and the clarity of the result. These corporations have also used the diagrams to describe clearly to their own people, what the organization is doing and proposes to do both in operations and in potential IS development.

INTRODUCTION

In today's analysis environment, speed of analysis, accuracy of representation and thoroughness are hallmarks of effective analysis. Whether one is moving to complete an Object Oriented Analysis [Taylor, 1992] or to use a traditional approach, gathering applicable information as early as possible is essential. One can form a more effective relationship early on with the client by having an effective dialogue that captures an understanding of the users problems and goals (many analysts consider the first meeting to have as the goal, rapport building), can feed them back to the client and then can subsequently deliver a visual summary a short time later in the form of a Constellation Diagram.

Constellation Diagrams are a form of organizational systems model that represents the IT resources, business processes, organizational structure and the end users in a business. These diagrams are meant to complement other Business Process Analysis modeling techniques. An important tool in Business Process Analysis has been the data flow diagram (DFD). McMaster and Voorhis [1996] proposed the "Forms Based Analysis Method", a methodology similar to the UML activity diagramming method [Fowler & Scott, 1992] that is used to gather information prior to creating a data flow diagram. Creating the data flow diagram required considerable mental processing on the part of the analyst if it was used to

gather information from the client, and created during an interview with the client. The forms based analysis technique with its orchestrated interview and easy information capturing process, was straight-forward to use when interviewing a client to gain an understanding of both the clients needs and the business needs, and which facilitated a more ready creation of the DFD or other diagrams such as the entity relationship diagram. This analysis and representation process allowed the analysis and subsequent software creation to be more effective as was demonstrated in many smaller businesses studies. However, we propose that Constellation Diagrams provide a more comprehensive organizational representation that helps clarify the scope of a project and the areas of study, which lead to a more effective analysis.

The systems analysis Constellation Diagrams described in this paper are most applicable for use in the initial stages of an IS project such as feasibility or requirements analysis. These diagrams are particularly useful in the following activities:

- Interviewing clients and note taking: It is our experience that during the analysis interview, that information is given to the analyst in a non-linear way. For example, the client might say, "Here is an important point to add to what we were talking about earlier." The analyst can then effectively capture it with the constellation diagram.

- Consolidating information from different people and sources: Since the constellation diagram is a network, these diverse information gatherings can be facilitated.

- Summarizing information and gaining an overview of an organization.

- Evaluating the parts and connections within an organization to uncover hidden relationships or requirements, which significantly aids in problem solving and analysis.

- Presenting and communicating information with others that shows the overall structure and purpose and goals of the organization under analysis

Businesses are often more than they appear to be from the outside and Constellation diagrams provide a technique for understanding them faster and more accurately. An example of an abbreviated Constellation diagram for a typical business school could look the following diagram:

Constellation diagrams deconstruct and display information about: internal structure (who the people are and how they are organized); external stakeholders (anyone external to the organization that has an interest in, or provides input on, what the organization does that goes beyond a simple supplier or vendor relationship, including, but not limited to, shareholders, directors, government, regulators and non-governmental organizations); processes (what the organization is intended to accomplish both in its present form and future goals); and information infrastructure (what information systems and IT infrastructure is used by the organization to accomplish its goals). Constellation diagrams can be very detailed, breaking things down into multiple levels, or they can provide a summary overview of an organization, depending on requirements.
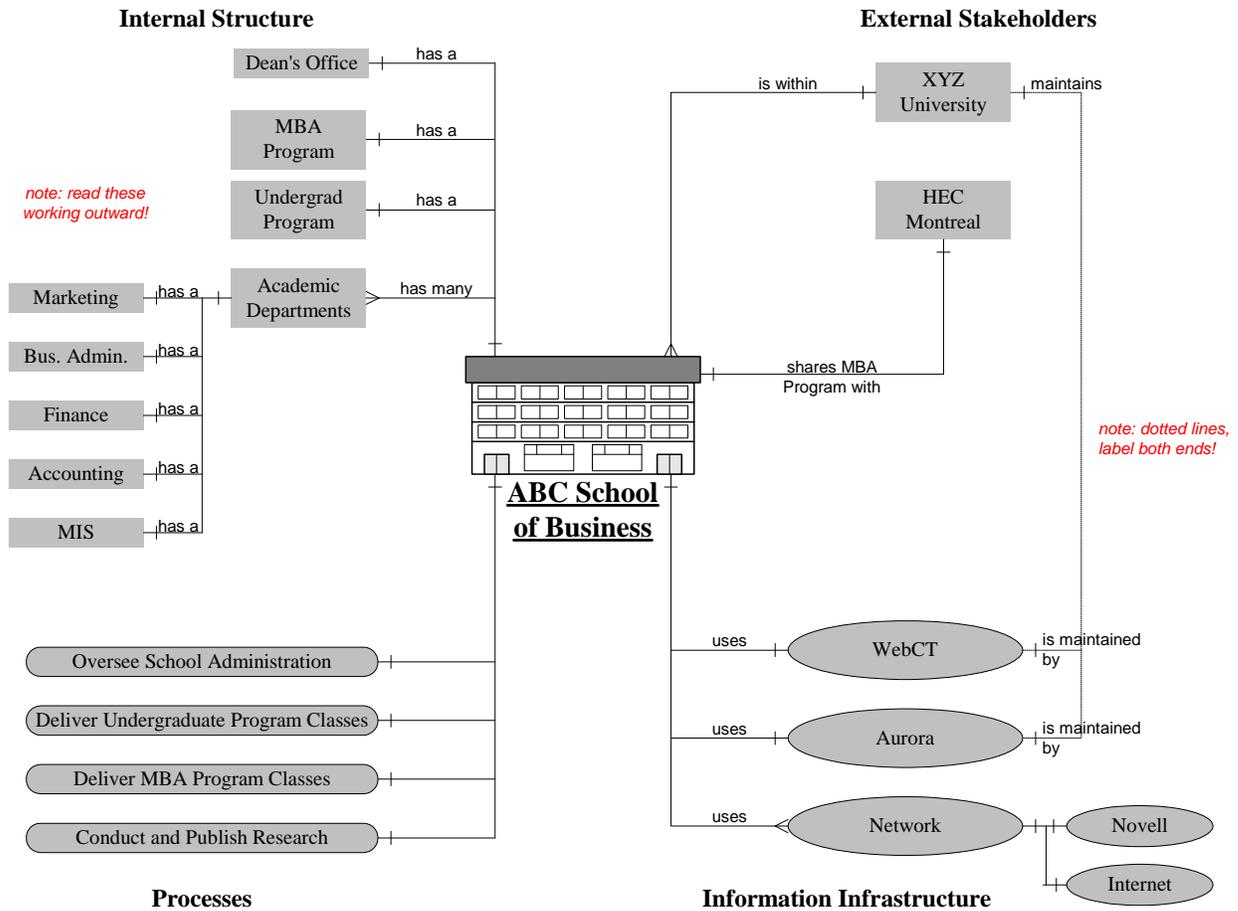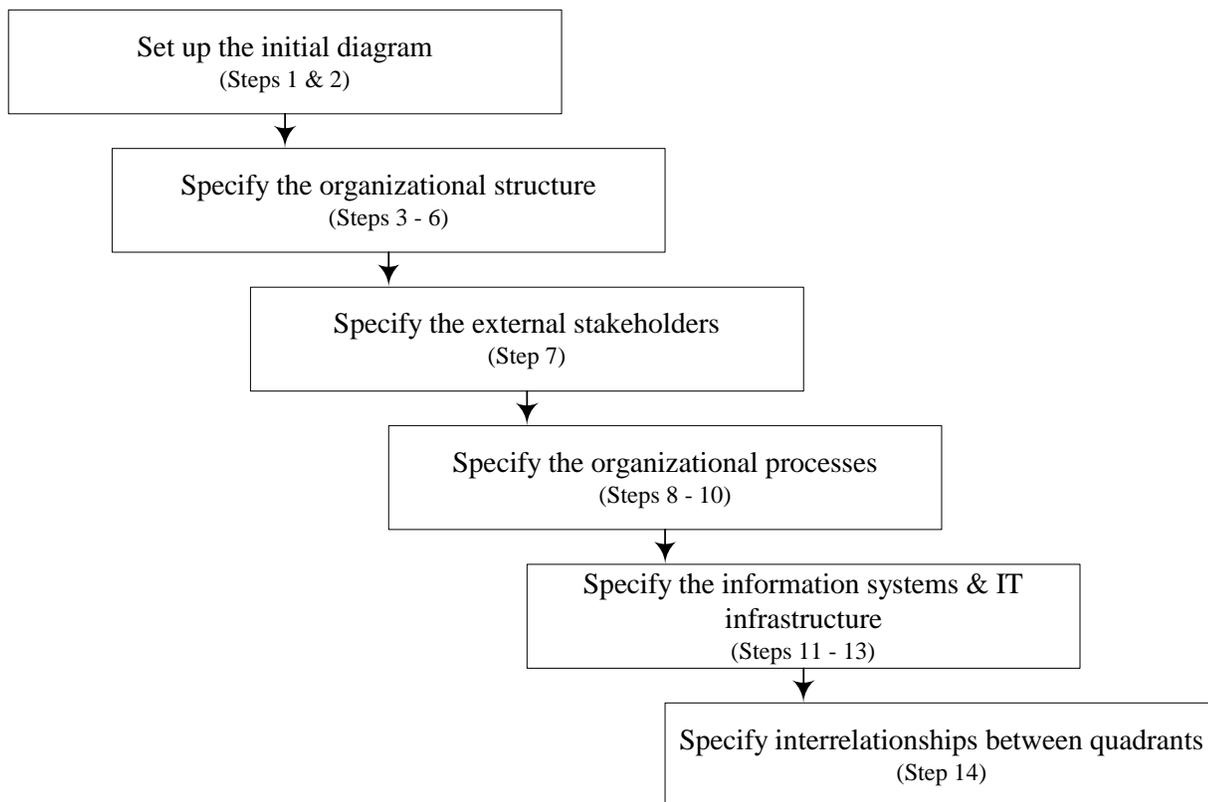
Figure 1: Sample Constellation Diagram to describe a business school.

Constellation diagrams provide the first step in business or process analysis and are useful for leading into other diagramming and analysis techniques such as quality improvement, process modeling, process mapping, use cases, data flow diagrams and entity relationship diagrams. Constellation diagrams are simple enough that almost everyone can read and understand one immediately. It is especially easy for the analyst to review with the client, a summary of their conversation using the Constellation diagram. We have found in our initial testing of this technique that clients are impressed with the depth of understanding of the situation by the analyst, and this respect facilitates a more effective analysis process. As the analyst reviews the situation in a summary walk-through, the client often thinks of additional information that will assist the understanding and representation of the situation. However, creating these diagrams takes practice – it is not difficult to begin creating them but being able to construct them quickly and accurately takes training, time and patience. During the discussion with the user, it is our experience, that capturing the information by hand with an 11 by 17 inch piece of paper and a pencil is most effective. However, subsequent to the interview, a visually pleasing Constellation Diagram can be created very quickly. With today's software packages, such as "MindManager" [2], the ability to create professional looking constellation diagrams is easy. The analyst can extensively use icons, internet links to relevant information pertaining to the interview, use of color, use note pages that

can be used to capture important linear information and flagged with an icon, use icon's to prompt and remind the analyst of time dependant information, all leading to a rich tool box for capturing useful information in a visually attractive way. Students trained in the methodology and who are "presentation adverse", give amazingly good presentation and are much more relaxed doing so. This is also true for the practicing analysts that we have worked with.

The Methodology for Creating Constellation Diagrams

In the remainder of this paper, we will describe 14 steps that we recommend in creating a Constellation Diagram. These steps are first illustrated in the box flow diagram below. You may notice that these steps are similar to many other organizational modeling techniques such as flowcharting, data flow analysis, forms based analysis method, activity diagrams or cause and effect diagrams that are used in business. Many of these techniques follow the same process of (1) identifying important elements of an organization or process, (2) grouping/arranging them according to common characteristics, and (3) defining and illustrating how they relate to each other in as complete a manner as possible.

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┌─────────────────────────────────┐
│   Set up the initial diagram    │
│        (Steps 1 & 2)            │
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          │
          ▼
    ┌─────────────────────────────────────┐
    │  Specify the organizational structure │
    │            (Steps 3 - 6)             │
    └─────────────────────────────────────┘
              │
              ▼
        ┌─────────────────────────────────┐
        │  Specify the external stakeholders │
        │           (Step 7)              │
        └─────────────────────────────────┘
                  │
                  ▼
            ┌─────────────────────────────────┐
            │ Specify the organizational processes │
            │          (Steps 8 - 10)         │
            └─────────────────────────────────┘
                      │
                      ▼
                ┌──────────────────────────────────────┐
                │ Specify the information systems & IT   │
                │            infrastructure              │
                │           (Steps 11 - 13)              │
                └──────────────────────────────────────┘
                          │
                          ▼
                    ┌──────────────────────────────────────────┐
                    │ Specify interrelationships between quadrants │
                    │                (Step 14)                   │
                    └──────────────────────────────────────────┘
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Figure 2: Important steps in creating constellation diagrams

Setting Up the Initial Diagram

Step #1:

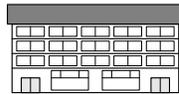Place the focal group or organization in the center of the diagram
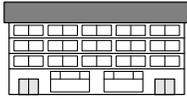
**ABC School
of Business**

Step #2:

Clockwise from the top left corner, label the four quadrants "Internal Structure", "External Stakeholders", "Information Infrastructure" and "Processes".

Internal Structure   **External Stakeholders**

**ABC School
of Business**

Processes   **Information Infrastructure**

___Internal Structure___: *The people within the focal group/organization, showing how they are organized and interrelated.*

___External Stakeholders___: *Anyone external to the organization that has an interest in, or provides input on, what the organization does that goes beyond a simple supplier or vendor relationship, including, but not limited to, shareholders, directors, government, regulators and non-governmental organizations.*

___Processes___: *Tasks that the focal group/organization performs in order to accomplish its goals.*

___Information Infrastructure___: *The IT systems (HW, SW, networks or services) that the focal group/organization uses when carrying out their processes.*

Specify the organizations Structure

Step #3:

Write down all the relevant people, departments and groups who are directly associated with the organization.

Lionel   Dean's
Bob   Office

Serge   Undergraduate
Ritu   office

Marketing
department

Step #4:

Organize the items in #3 into logical units or collections that best represent the organization and determine the relevant names for each unit/collection.

Unit #1: Dean's office: (Bob, …),

Unit #2: Undergraduate office (Ritu, Serge, …)

*Unit #3: Academic Departments: Marketing (Lionel, …), Business Administration (…)*

Step #5:

Draw lines to connect each group with the organization and select the proper relationship symbols and labels for each connection. If groups are interrelated, indicate the connections and label them accordingly.

Academic
Departments   has many

**ABC School
of Business**
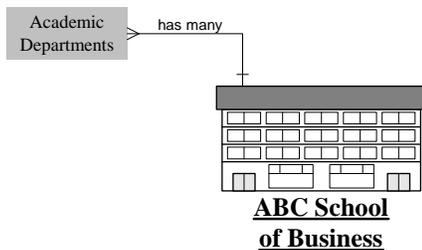
Step #6:

Continue grouping and relating the contents of each collective until the desired level of detail is achieved.
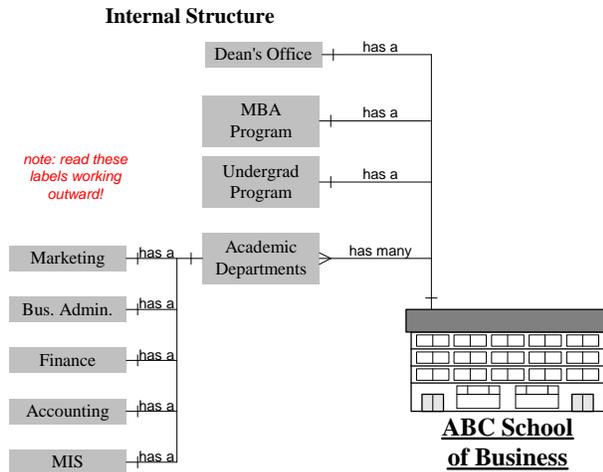
*Note: Since the remaining steps follow the same **I**dentify → **G**roup → **R**elate procedure as illustrated above, further diagram snippets will not be included. Refer to the full diagram on the first page if clarification of a step is required.*

Stakeholders

Step #7:

Identify all relevant individuals or organizations that are directly associated with the focal organization and repeat steps 3-6 to group and relate them.

Processes

Step #8:

Identify the primary tasks that the organization is responsible for.

Step #9:
Group and relate these primary tasks with respect to the organization.

Step #10:
For each primary task, identify the next-level subtasks and group and relate accordingly. Continue until the desired level of detail is achieved.

Information Infrastructure

Step #11:

Identify the primary information systems and IT infrastructure components that are used directly by the organization.

Step #12:

Group and relate these systems with respect to the organization.

Step #13:

For each primary system, identify the next-level subsystems and group and relate accordingly. Continue until the desired level of detail is achieved.

Interrelationship Between Quadrants

Step #14:

Identify relevant interrelationships between items in different quadrants and indicate these interrelationships with the correct symbols and labels

Symbols and Labels in Constellation Diagrams

Basic Drawing Rules

Line up items so that they are positioned in straight lines both vertically and horizontally. Similar items should be similar sizes. Always use straight lines that are vertical or horizontal (no diagonal lines) and all line connections or bends must be at 90 degrees. Organize your diagram so as to minimize line that cross one another or that have excessive angles in them.

Use solid lines to show relationships within a quadrant and between a quadrant and the focal organization. Use dotted lines to show interrelationships between quadrants.

During the course of an interview, the analyst may learn other important facts about the business. If the four quadrants are kept in their respective areas on the page then there should be extra room in between the quadrants for any information that does not fit under any of the categories. The purpose of the constellation diagram is to collect as much information about the organization as is practical. However, there could be information that may be useful in the diagramming processes that is not represented by the four categories. Drawing a pointed rectangle around this extra information will distinguish it from the rest of the information in the diagram.

Symbols

Internal Structure	People, Departments, Groups, etc.	Rectangle
Stakeholders	People, Departments, Groups, etc.	Rectangle
Processes	Primary and sub-processes	Rounded Rectangle
Information Infrastructure	Systems and subsystems	Ellipse
Notes or Additional Information	Information that does not fit into the other four categories	Pointed Rectangle

Relationships

Cardinality		One, and only one. For example, in the diagram on the first page there is one, and only one, ABC school of business within the context of the diagram.
		Many, or simply 'more than one'. For example, in the diagram on the first page there are many academic departments in the ABC school of business.

LABELS

Relationships can be labeled in order to provide additional information to the reader about the organization in a Constellation diagram. There are no absolute rules that state what a valid label is or is not but there are common labels that exist. Since Constellation diagrams often show collective-style relationships (for example, 'Academic Departments' is a collection of many similarly-structured groups called 'Marketing', 'Accounting', etc.), common relationship labels are 'has many', 'has a' and 'is a'. These labels are not the only ones to use and in many cases a person must create their own descriptive label. Labels must concisely specify the relationship and make sense to the reader. It is important to be as specific as possible when deciding on how to label a relationship. For example, while the relationship between ABC School of Business and WebCT in the diagram on page one might be labeled 'has a' (since the school does 'have' a WebCT system), it is much more accurate and informative to label this relationship as 'uses' in order to specify that the school not only has a WebCT system but that it actually uses it as a part of delivering on its primary task of delivering undergraduate program classes.

Often when showing students and novice analysts this process for creating the systems analysis diagram, we ask them to make up a shadow constellation diagram that contains a list of questions that the analyst will ask during the interview and that will help them to extract the information and keep the interview

flowing smoothly. In particular, the text by Whitten and Bentley is an effective source for ideas in constructing such an analyst's tool. Some ideas for creating the diagrams follow.

- Start with pencil and paper and start sketching your diagram early on in the process.

- Leave lots of space to begin with so that you have room to add and revise as you learn more about the organization. It's a good idea to use 11x17-sized paper to begin the early sketches.

- Begin labeling relationships using single words or simple phrases that describe how two items relate to each other, but be consistent in your use of words or phrases. Avoid using different labels such as 'uses' and 'makes use of' if 'uses' could accurately apply for both situations.

- Always look for relationships between the items in the diagram and add these in when they become apparent. The strength of a Constellation diagram is in showing the relationships, dependencies and complexity in an organization.

- Start at the highest collective level of a group of related items and work down from there. For example, if an organization uses only MS Office as its common default software package then it might be most appropriate to indicate "MS Office Suite, XP version" as a top-level item under "Information Infrastructure". However, if both MS Office as well as the open source StarOffice suite are both used in an organization (perhaps the business allows employees to use either software suite, depending on individual user preference) then the top-level item might be better labeled "Office Software" and the second-level items could then indicate "MS Office Suite, XP version" and "StarOffice, version 4.5.6".

- Sketch in an Icon or idea for an Icon to capture or supplement an idea or concept pictorially.

CONCLUSION

Developmental versions of Constellation Diagrams have been in use by the authors for over 20 years and have assisted in the successful analysis of such major corporations as We Care Home Health Services (cdn) and the Canadian Diabetes Society. They have formed part of the literature for the "Discovery Process" in attracting new franchisees to join a franchise system and to give them a quick overview. They have also been used in training third year Computer Science students in co-op classes where analysis techniques must be subsequently applied to analyze a real business and the students must present their findings and recommendations to the business principals. Many of the times, significant software is then developed for the corporations involved using the results of the analysis. Recently, the methodology has been successfully taught to second year business students at the Asper School of Business in Winnipeg, Manitoba.

Constellation diagrams are non-technical. There is nothing on a Constellation diagram which is not easily understandable to business people who are familiar with the business area depicted, whether or not they are computer literate. Their graphic nature and use of icons, and the excellent software for

developing them, and manipulating them interactively, greatly assists in the excellence of a presentation to the user.

However, because Constellation Diagrams show the people and business processes in a company and the IT systems used to carry out those processes, they can be used be IS analysts and software developers to quickly understand business processes and requirements in a comprehensive manner. Constellation diagrams show relationships between people, processes and information systems in a way that facilitates communication between IT and non-IT people. In our experience, this greatly speeds up and enhances the systems analysis process, making Constellation Diagrams an essential entry point to the systems analysis process.

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