

3

Proposed Framework

3.1

Briefly Review of Research Design

Yin (2009) defines research design as “... a plan that guides the investigator in the process of collecting, analyzing, and interpreting observations. It is a logical model of proof that allows the researcher to draw inferences concerning causal relations among the variables under investigation...”.

He also emphasizes that a research design is much more than a work plan. The main purpose of the design is to avoid situation in which the evidence does not address the initial research questions.

Creswell (2009) also provides a definition of research design as “...plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis...”

He presents three types of research designs:

- **Qualitative research** is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures, data typically collected in the participant’s setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. The final written report has a flexible structure. The following is a synthesis of commonly articulated assumptions regarding characteristics of a qualitative research:
 - Qualitative research occurs in natural settings, where human behavior and events occur.
 - Qualitative research is based on assumptions that are very different from quantitative designs. Theory or hypotheses are not established a priori.
 - The data that emerge from a qualitative study are descriptive. That is, data are reported in words or pictures, rather than in numbers.

- Qualitative research focuses on the process that is occurring as well as the product or outcome.
- This research tradition relies on the utilization of tacit knowledge (intuitive and felt knowledge) because often the nuances of the multiple realities can be appreciated most in this way.
- **Quantitative research** is a means for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures. The final written report has a set structure consisting of introduction, literature and theory, methods, results, and discussions. Those who engage in this form of inquiry have assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations, and being able to generalize and replicate the findings.
- **Mixed methods research** is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both approaches in a study. Thus, it is more than simply collecting and analyzing both kinds of data; it also involves the use of both approaches in tandem so that the overall strength of a study is greater than either qualitative or quantitative research.

Creswell (2009) also states that research design involves the intersection of philosophy, strategies of inquiry and specific methods as illustrated in the figure 10 :

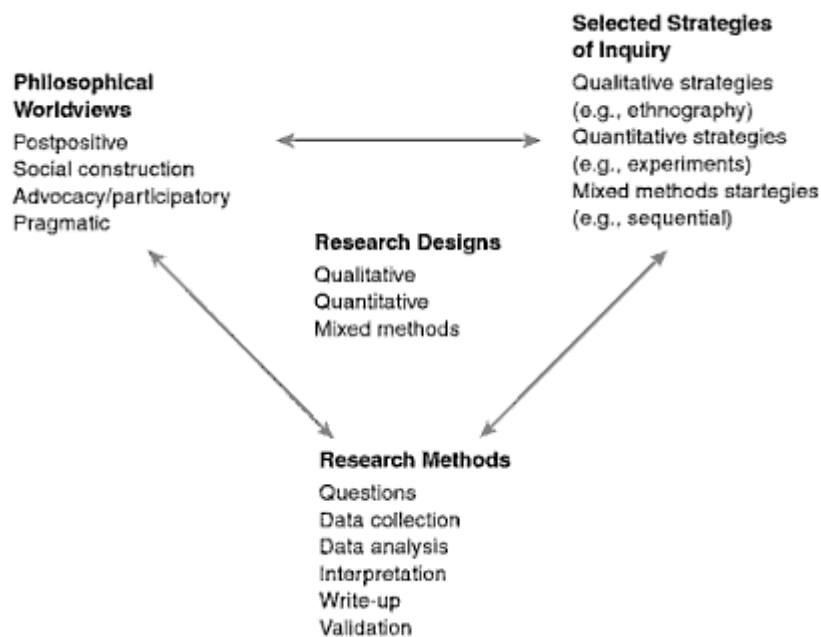


Figure 10 – Framework for Research Design (Creswell, 2009)

- **Philosophical worldviews** – the term “*worldview*” has a meaning of “a basic set of beliefs that guide action”. Other authors have called them *paradigms*, *epistemologies* or *broadly conceived research methodologies*. Creswell (2009) describes the worldviews as a general orientation about the world and the nature of research that a researcher holds. The types of beliefs held by individual researchers will often lead to embracing a qualitative, quantitative, or mixed methods approach in their research. Four different worldviews are proposed: Postpositivism, Constructivism, Advocacy and Pragmatism.
- **Strategies of inquiry** – are types of qualitative, quantitative, and mixed methods designs or models that provide specific direction for procedures in a research design. Other authors have called them *approaches to inquiry* or *research methodologies*.
 - **Quantitative strategies** which include surveys and experiments:
 - **Survey research** provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population. It includes cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection, with the intent of generalizing from a sample to a population.

- **Experimental research** seeks to determine if a specific treatment influences an outcome. This impact is assessed by providing a specific treatment to one group and withholding it from another and then determining how both groups scored on an outcome. Experiments include true experiments, with the random assignment of subjects to treatment conditions, and quasi-experiments that use nonrandomized designs.
- **Qualitative strategies** which include ethnography, grounded theory, case studies, phenomenological research, narrative research.
 - **Ethnography** is a strategy of inquiry in which the researcher studies an intact cultural group in a natural setting over a prolonged period of time by collecting, primarily, observational and interview data. The research process is flexible and typically evolves contextually in response to the lived realities encountered in the field setting.
 - **Grounded theory** is a strategy of inquiry in which the researcher derives a general, abstract theory of a process, action, or interaction grounded in the views of participants. This process involves using multiple stages of data collection and the refinement and interrelationship of categories of information. Two primary characteristics of this design are the constant comparison of data with emerging categories and theoretical sampling of different groups to maximize the similarities and the differences of information.
 - **Case studies** are a strategy of inquiry in which the researcher explores in depth a program, event, activity, process or one of more individuals. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time.

- **Phenomenological research** is a strategy of inquiry in which the researcher identifies the essence of human experiences about a phenomenon as described by participants. In this process, the researcher brackets or sets aside his or her own experiences in order to understand those of the participants in the study.
- **Narrative research** is a strategy of inquiry in which the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives. This information is then often retold by the researcher into a narrative chronology.
- **Mixed methods strategies** which include sequential mixed methods, concurrent mixed methods and transformative mixed methods.
 - **Sequential mixed methods** procedures are those in which the researcher seeks to elaborate on or expand on the findings of one method with another method. This may involve beginning with a qualitative interview for exploratory purposes and following up with a quantitative, survey method with a large sample so that the researcher can generalize results to a population. Alternatively, the study may begin with a quantitative method in which a theory or concept is tested, followed by a qualitative method involving detailed exploration with a few cases or individuals.
 - **Concurrent mixed methods** procedures are those in which the researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. In this design, the investigator collects both forms of data at the same time and then integrates the information in the interpretation of the overall results. Also, in this design, the researcher may embed one smaller form of data within another larger data collection in order to analyze different types of questions.

- **Transformative mixed methods** procedures are those in which the researcher uses a theoretical lens as an overarching perspective within a design that contains both quantitative and qualitative data.
- **Research methods** – It involve the forms of data collection, analysis, and interpretation that researchers propose for their studies.

Creswell (2009) proposes to consider the following criteria for selecting a research design:

- **Research problem** – Certain types of social research problems call for specific approaches. For example, problems that call for the identification of factors that influence an outcome, or the utility of an intervention or understanding the best predictors of outcomes, are best suited with quantitative approach. On the other hand, if a concept or phenomenon needs to be understood because little research has been done on it, then a qualitative approach provides a better method.
- **Personal experience** – Researchers' own personal training and experience also influence their choice of approach. For example, individuals trained in technical, scientific writing, statistics, and computer statistical programs will most likely choose the quantitative design. On the other hand, individuals who enjoy writing in a literary way or conducting personal interviews or making up close observations may choose qualitative approach. Qualitative approach allows room to be innovative and to work more within researcher-designed frameworks.
- **Audience** – Researchers write for audiences that will accept their research. These audiences may be journal editors, journal readers, conference attendees, etc. The experiences of these audiences with quantitative, qualitative, or mixed methods studies can shape the decision about this choice.

For more information on the different types of research design and strategies, it is suggested to refer to the work done by Creswell (2009).

3.2

Building Theory from Case Study Research

Yin (2009) defines case study research as “...An empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident...”. He complements this definition saying that case study inquiry:

- Copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis.

Yin (2009) states that case study research should be used when a “how” or “why” research question is being asked about a contemporary set of events, over which the researcher has little or no control. He also provides a comparison of case study with other research methods as detailed in the table 3 below:

Table 3 – Relevant Situations for Different Research Methods (Yin, 2009)

Method	Form of research question	Requires control of behavior events?	Focuses on contemporary events?
Experiment	How, Why?	Yes	Yes
Survey	Who, What, Where, How many, How much?	No	Yes
Archival Analysis	Who, What, Where, How many, How much?	No	Yes / No
History	How, Why?	No	No
Case Study	How, Why?	No	Yes

Yin (2009) presents the traditional prejudices against case study method:

- Lack of rigor due to the researcher had not followed systematic procedures, or had allowed equivocal evidence or biased views to influence the direction of the findings and conclusions. For this prejudice, he argues that bias can also enter in the conduct of experiments and the use of research methods, such as designing questionnaires for surveys or conducting historical research.
- Provides little basis for scientific generalization. The answer to this statement is that case studies, like experiments, are generalizable to theoretical propositions and not to populations or universes.
- Cases studies take too long and they result in massive, unreadable documents. This complaint may be appropriate, given the way case studies have been done in the past, but this is not necessarily the way case studies must be done.

Based on Yin (2009), four tests have been commonly used to establish the quality of any empirical social research. Because case studies are one form of such research, the four tests are also relevant to case studies, and are described below:

- Construct validity: Identifying correct operational measures for the concepts being studied.
 - Case study tactics: Use of multiple sources of evidence, establish chain of evidence, have key informants review draft case study report
- Internal validity: Seeking to establish a causal relationship, whereby certain conditions are believed to lead to other conditions, as distinguished from spurious relationships (for explanatory or causal studies only and not for description or exploratory study)
 - Case study tactics: Pattern matching, explanation building, address rival explanations, use of logic models
- External validity: Defining the domain to which a study's finding can be generalized

- Case study tactics: Use theory in single-case studies, use replication logic in multiple-case studies
- Reliability: Demonstrating that the operations of a study, such as the data collection procedures can be repeated with the same results
 - Case study tactics: Use case study protocol, develop case study database

A primary distinction in designing case studies is between single and multiple case designs. The single-case study is an appropriate design for the following circumstances:

- When it represents the critical case in testing a well-formulated theory. The theory has specified a clear set of propositions as well as the circumstances within which the propositions are believed to be true, and the single case that meets all of the conditions for testing the theory, can confirm, challenge, or extend the theory.
- When the case represents an extreme case or a unique case.
- When a single case is the representative or typical case. In this case, the objective is to capture the circumstances and conditions of an everyday situation.
- When it is a revelatory case. This situation exists when an investigator has an opportunity to observe and analyze a phenomenon previously inaccessible to social science inquiry.
- When it is a longitudinal case, which means, studying the same single case at two or more different points in time.

The same study may contain more than a single case. When this occurs, the study has used a multiple-case design, and such designs have increased in frequency in recent years.

Based on Yin (2009), multiple-case designs have distinct advantages and disadvantages in comparison to single-case designs. The evidence from multiple cases is often considered more compelling, and the overall study is therefore regarded as being more robust. Herriott and Firestone (1983). At the same time,

the rationale for single-case designs cannot usually be satisfied by multiple cases when it is considered unusual or rare case, critical case, and the revelatory case.

He also states that the replication logic for multiple-case studies is analogous to that used in multiple experiments. Some of the replications might attempt to duplicate the exact conditions of the original experiment while others might alter one or two experimental conditions considered unimportant to the original finding, to confirm whether the finding could still be duplicated. Each case must be carefully selected so that either predicts similar results (literal replication) or predicts contrasting results but for anticipatable reasons (theoretical replication). A few cases (2 or 3) would be literal replications, whereas a few other cases (4 to 6) might be designed to pursue two different patterns of theoretical replications.

Eisenhardt (1989) describes the process of inducting theory using case studies from specifying the research questions to reaching closure. She argues that this research approach is especially appropriate in new topic areas, and the resultant theory is often novel, testable, and empirically valid.

She states that in normal science, theory is developed through incremental empirical testing and extension, and thus, the theory-building process relies on past literature and empirical observation or experience as well as on the insight of the theorist to build incrementally more powerful theories. However, she highlights that there are times when little is known about a phenomenon, current perspectives seem inadequate because they have little empirical substantiation, or they conflict with each other or common sense, or there is a need for a new perspective. In these situations, theory building from case study research is particularly appropriate because theory building from case studies does not rely on previous literature or prior empirical evidence.

In sum, building theory from case study research is most appropriate in the early stages of research on a topic or to provide freshness in perspective to an already researched topic.

These characteristics of theory building from case study seem to fit well with the proposed research problem stated in this thesis as the main objective is to develop a framework for assessing and guiding companies' progress towards a Demand Driven Supply Chain concept, which is not clearly defined yet in the academic literature and not fully executed in practice by supply chain professionals.

Before establishing this method as the basis for this research, it is important to understand the strengths and weaknesses of theory-building from case study, which is summarized in table 4 below:

Table 4 – Strengths and Weaknesses of Building Theory from Case Study
(Eisenhardt, 1989)

Strengths	Weaknesses
Likelihood of generating novel theory	Intensive use of empirical evidence can yield theory which is overly complex
Resultant theory is likely to be empirically valid. The likelihood of valid theory is high because the theory-building process is so intimately tied with evidence that it is very likely that the resultant theory will be consistent with empirical observation	Building theory from cases may result in narrow and idiosyncratic theory. (It is a bottom up approach and there is a risk of not being able to raise the level of generality of the theory)
Emergent theory is likely to be testable with constructs that can be readily measured and hypotheses that can be proven false	

In terms of evaluation of theory-building research using case studies, Eisenhardt (1989) states that there is no generally accepted set of guidelines for the assessment of this type of research, but several criteria seem appropriate like:

- Assessment on whether the concepts, framework, or propositions that emerge from the process are “good theory”, which is defined as parsimonious, testable, and logically coherent theory.
- Assessment of theory building based on the strength of method and the evidence of grounding theory like checking if the researchers followed a careful analytical procedure, that the evidence support the theory.
- Strong theory-building research should result in new insights. Theory building which simply replicates past theory is, at best, a modest contribution. Thus, a strong theory building study presents new, perhaps framebreaking insights.

Another important contribution to develop solutions to practical problems that follows the same “*school of thought*” comes from Van Aken (2004), where he proposes the paradigm of *Design Sciences* which has the mission to develop knowledge to solve construction problems, or to be used in the improvement of the performance of existing entities, i.e. to solve improvement problems.

He explains the differences of design sciences to *formal sciences* which has the mission to build systems of propositions whose main test is their internal logical consistency, and also to *explanatory sciences* which has the mission to describe, explain and possibly predict observable phenomena within its field. Table 5 below summarizes the main differences between explanatory sciences and design sciences:

Table 5 – Main Differences between Explanatory and Design Sciences (Van Aken, 2004)

<i>Characteristic</i>	<i>Description-driven research programmes</i>	<i>Prescription-driven research programmes</i>
Dominant paradigm	Explanatory sciences	Design sciences
Focus	Problem focused	Solution focused
Perspective	Observer	Player
Logic	Hindsight	Intervention-outcome
Typical research question	Explanation	Alternative solutions for a class of problems
Typical research product	Causal model; quantitative law	Tested and grounded technological rule
Nature of research product	Algorithm	Heuristic
Justification	Proof	Saturated evidence
Type of resulting theory	Organization Theory	Management Theory

A design science does not develop knowledge for the layman, but rather for professionals in its field, which means that design knowledge is to be applied by individuals who have received formal education in that field. In the design sciences, the research object is a “*mutandum*”, and these sciences are not much interested in *what is*, but more in *what can be*. The typical research product is a “*technological rule*” which is defined by Van Aken as “...*a chunk of general knowledge, linking an intervention or artifact with a desired outcome or performance in a certain field of application...*”

He also emphasize that professionals have a repertoire of design knowledge at their disposal to make these design, which one of them is their own personal experience.

For more information about the design sciences, please refer to van Aken (2004).

3.3

Research Method for Developing DDSC Assessment Framework

The research followed a design-oriented methodology similar to the one applied by Verdouw et al. (2010) to develop a reference process modeling for the fruit industry in Europe to become a demand driven supply chain.

Design-oriented research is typically involved with “how” questions, i.e. how to design a model or system that solves a certain problem, as stated by Van Aken, 2004. This research applies a design-testing approach, which is comparable with theory testing methods in traditional empirical science, as explained by Eisenhardt (1989). In such approach, generic design knowledge is developed based on deductive reasoning, and after that, the design is tested by applying it to specific cases. In this research, the proposed assessment framework is applied in a multiple case study in the beverage industry.

Four different countries were preselected to review the proposed maturity model and answer the assessment to identify current and future states based on demand driven supply chain concepts. In this way, it will be possible to validate the proposed maturity model at the same time that companies’ current and future states are identified. The main criteria to select the countries were their market maturity, interviewees’ supply chain practical experience, and author’s knowledge of their operations.

The research is organized in 4 main steps: (i) Literature review, (ii) Development of maturity model, (iii) Case investigation and analysis through application in 4 operations and (iv) Review of maturity model based on feedback from practitioners. A proposed framework describing each step was developed and is detailed in the next section.

3.4

Proposed DDSC Framework

In this section, the proposed framework used to develop the DDSC maturity model will be described, and also the proposed steps to perform the assessment process.

A methodology is defined as a structured collection of stages that have to be carried out in order to achieve business improvement. This is usually given in the form of a flowchart that defines, for each stage, what should be done, when, how, why and by whom.

In order to solve the problem previously described, it is proposed a new framework consisting of a Two-phase approach that is illustrated in the framework of figure 11:

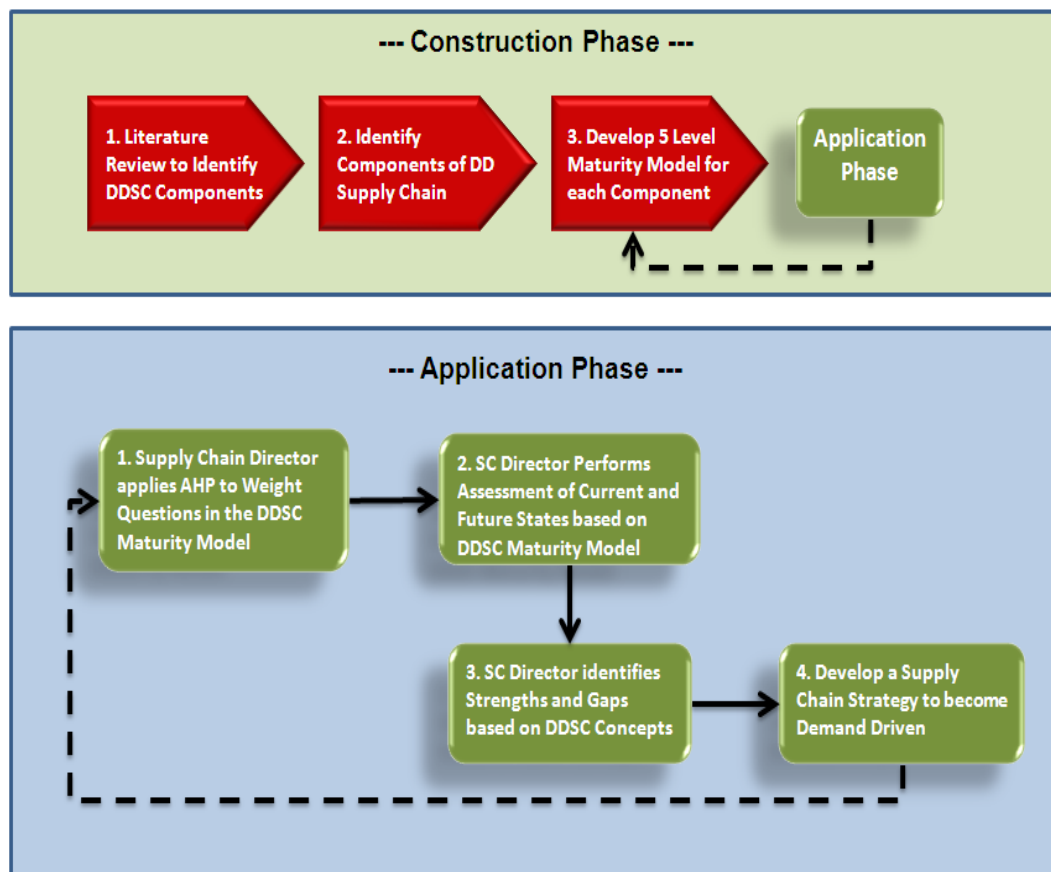


Figure 11 – Author's Integrated Methodology to Assess DDSC

The first phase is called the "**Construction Phase**" and aims to identify the DDSC components and develop the Demand Driven Supply Chain Maturity Model, and comprehends 3 major steps, as described below:

- **Steps 1 and 2 – Literature Review and Identify DDSC Component:**

In the first two steps, the academic literature currently available is reviewed and also explored practical experience from the author, who has more than 17 years of practical experience in leading and developing logistics & supply chain management projects worldwide to identify and define the components of a Demand Driven Supply Chain.

This is a very important step in the proposed methodology as the DDSC concepts are not currently gathered and documented in one single source, as confirmed during the literature review done in chapter 2.

- **Step 3 – Develop 5 Level Maturity Model for each Component:**

Based on the characteristics identified in the previous steps, a five level maturity model will be developed, ranging from a level 1 (low adherence) to level 5 (full implemented) of DDSC concepts that will serve as the basis to perform the assessment of current and future states.

A maturity model can be described as a structured collection of elements that describe certain aspects of maturity in an organization, and aids in the definition and understanding of the different organization processes.

The Capability Maturity Model (CMM) was originally developed as a tool for objectively assessing the ability of government contractors' processes to perform a contracted software project. The CMM is based on the Process Maturity Framework first described in "Managing the Software Process" by Watts Humphrey (1989) and later published in its full form as a book in 1995 by Mark Paulk, Charles Weber, Bill Curtis, and Mary Beth Chrissis.

Though it comes from the area of software development, it has also been applied to improving organizational processes in diverse areas, like software engineering, system engineering, project management, software maintenance, risk management, system acquisition, information technology (IT), services, business processes, and human capital management.

There are five standard levels defined along the continuum of the CMM, as described below:

Level 1 - Ad hoc (Chaotic)

It is characteristic of processes at this level, that they are (typically) undocumented and in a state of dynamic change, tending to be driven in an ad hoc, uncontrolled and reactive manner by users or events. This provides a chaotic or unstable environment for the processes.

Level 2 - Repeatable

It is characteristic of processes at this level, that some processes are repeatable, possibly with consistent results. Process discipline is unlikely to be rigorous, but where it exists, it may help to ensure that existing processes are maintained during times of stress.

Level 3 - Defined

It is characteristic of processes at this level that there are sets of defined and documented standard processes established, and subject to some degree of improvement over time. These standard processes are in place and used to establish consistency of process performance across the organization.

Level 4 - Managed

It is characteristic of processes at this level that using process metrics, management can effectively control the process. In particular, management can identify ways to adjust and adapt the process to particular projects without measurable losses of quality or deviations from specifications. Process Capability is established from this level.

Level 5 - Optimizing

It is a characteristic of processes at this level that the focus is on continuous improving process performance through both incremental and innovative technological changes / improvements.

The second phase is called an “**Application Phase**” and aims to apply the framework in the different operations and countries to identify the current state and develop the supply chain strategy to become a Demand Driven organization, and comprehends 4 major steps, described below:

- **Step 1 – Supply Chain Director Applies AHP to Weight Components and Categories in the DDSC Maturity Model:**

The first step of the Application Phase consists of having the supply chain directors, who are responsible to develop the supply chain strategy for their organizations, providing their view and weighting the importance for each component and categories in the DDSC maturity model through a set of different weights that needs to be reconciled in one integrated view for the company under analysis.

The application of an audit / assessment process is referred by Salama et al (2009) as an important step companies should perform in order to achieve business improvements and face the competitive pressure of today's high dynamic markets. They also argue that sometimes process

related problems are not solved because companies fail to identify them, and on the other hand, the evaluation of innovative technologies or managerial practices can represent a way not only to solve hidden problems, but also to develop new business models and allow to do things that the organization is not already doing.

To that end, it is needed a robust approach to generate this final integrated set of weights, and in this methodology, it is proposed to apply the Analytic Hierarchic Process (AHP).

Based on Saaty and Vargas (2006) there are two known ways to analyze causal influences and their effects. One is by using traditional deductive logic beginning with assumptions and carefully deducing an outcome from them. This is a linear and piecemeal approach in which several separate conclusions may be obtained and the problem is to piece them together in some coherent way to have an integrated outcome.

The other way is to have a holistic approach in which all the factors and criteria involved are laid out in advance in a hierarchy or in a network system that allows for dependencies. All possible outcomes that can be thought of are joined together in these structures, and then, both judgment and logic are used to estimate the relative influence from which the overall answer is derived. This approach requires knowledge and experience with the subject, and is not totally dependent on the ability to reason logically which most people cannot do well.

Table 6 below provides a summary of the advantages and disadvantages of the AHP process:

Table 6 – Advantages and Disadvantages of AHP

Advantages	Disadvantages
Accommodates multiple criteria	Length of the process, which increases with the number of levels and number of pairwise comparisons
Model is simple, intuitive, but has mathematical rigor	Expense of commercial software to make the approach easily implemented
Integrates subjective judgments with numerical data	If not properly implemented, it can generate inconsistencies due to the pairwise comparisons
Facilitate decision maker participation	
Encourages a process of learning, debate and revision from multiple participants	
Allows building alternative scenarios to cope with medium / long term uncertainty	

The AHP is a general theory of measurement. It is used to derive relative priorities on absolute scales from both discrete and continuous paired comparison in multilevel hierarchic structures. The AHP has a special concern with departure from consistency and the measurement of this departure, and with dependence within and between the groups of elements of its structure. In order to use the AHP to model a problem, a hierarchic structure to represent the problem is needed, as well as pairwise comparisons to establish relations within the structure.

- **Step 2 – Supply Chain Director Performs Assessment of Current and Future States based on DDSC Maturity Model:**

The second step is to have supply chain directors performing an assessment of current and future states in light of the DDSC concepts.

This step should be performed very honestly and with an open mind in order that the results really reflect the current state of the operation under analysis, otherwise, the company will not be able to understand what the improvement opportunities are and how to move towards DDSC.

- **Step 3 – Identify Strengths and Gaps based on DDSC Concepts:**

Based on the results, the company will be able to identify the strengths and gaps of current state, and use this information to develop a supply chain strategy to move to future state, which represents the desired state in one year time in the future.

- **Step 4 – Develop a Supply Chain Strategy to become DDSC:**

The last step of the framework is to develop a supply chain strategy that will allow the company to identify the steps required to become a demand driven supply chain.

This development should be performed aligned with the company strategic business planning process, as supply chain is a key enabler of business improvement and can help the company achieve top level business goals like revenue growth, increase asset utilization and profitability, improve customer service, just to name a few examples.

In order to have formal evidence that the proposed framework is robust, methodological consistent and practical, supply chain directors for the first

implementation will be asked to provide their feedback about the 5-level maturity model descriptions and the proposed approach using AHP model.

After applying the framework in practice and based on the feedback received from supply chain directors, the maturity model and the proposed approach will be reviewed if needed, to make any necessary adjustment or changes, in order to better reflect the concepts of demand driven supply chain.