Project Management Constraint Theory – and a new Category of Constraints to Ensure Positive Outcomes
(Version 2)

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Summary

In difficult economic times, "doing more with fewer resources" requires smarter planning and new concepts to help your Projects succeed. This Paper introduces the new concepts of Project Management Constraint Theory and a Category of Constraints to Ensure Positive Outcomes. Definitions of Constraints and Risks are analyzed.

Project Management Constraint Theory is the identification, definition, categorization, utilization, modification, planning, implementation, and control of Project Constraints. Constraints may be grouped into Categories. A new Category of Constraints is presented below, called Constraints to Ensure Positive Outcomes (C-TEPO), which is a set of rules affecting a Project to bring about positive outcomes and to enhance Project performance and success.

> ➤ An example of C-TEPO is the requirement by an organization that Earned Value measurements and reports be required in a selected Project. This Constraint is mandated so that ongoing schedule and cost variance information will be reviewed regularly by management for the purpose of applying corrective action quickly, if needed, to make the Project successful.

Another Category of Constraints was described by the author in a previous Paper (Kozy, 2008), and is defined and summarized below for the reader.

This Paper presents a sample Project describing how to apply these new concepts, with tools and methodology to identify and develop Project Constraints. A Template and processes are included for Project Managers who want to apply these concepts to help their future Projects be successful, to produce tangible and/or intangible benefits, and to show the value of their Project Management.

Definitions in the PMBOK ® Guide and Examples

"***Constraint***. The state, quality, or sense of being restricted to a given course of action or inaction. An applicable restriction or limitation, either internal or external to the project, that will affect the performance of the project or a process.

➤ For example, a schedule constraint is any limitation or restraint placed on the project schedule that affects when a schedule activity can be scheduled and is usually in the form of fixed imposed dates." (PMI, 2008, p. 429)

"*Risk*. An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives." (PMI, 2008, p. 446)

➤ Example of a negative Risk (threat): An equipment supplier notifies you that it may not be able to deliver your order on the date expected in your Project Schedule. As the equipment's delivery is on your critical path, this uncertain event, late delivery, could result in a later than expected Project completion.

➤ Example of a positive Risk (opportunity): An equipment supplier notifies you that it may be able to deliver the Project's order two weeks earlier than expected in your Project Schedule. As the equipment's delivery is on your critical path and the installers are able to install the equipment early, this uncertain event, early delivery, could result in an earlier than expected Project completion.

"*Assumptions*. Assumptions are factors that, for planning purposes, are considered to be true, real, or certain without proof or demonstrations. *Assumption Analysis.* A technique that explores the accuracy of assumptions and identifies risks to the project from inaccuracy, inconsistency, or incompleteness of assumptions." (PMI, 2008, p.427)

➤ Example of an Assumption: Your organization will not close, run out of funds, or cancel your Project.

Key Differences between Constraints, Risks, and Assumptions

Constraints are different from Risks because the causes of each Constraint are certain and have either a 100 percent probability of occurring or no probability of occurring. (See Exhibit 1: Graphical and Mathematical Representation)

➤ Examples of common Constraints described in *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fourth Edition* published by the Project Management Institute (PMI®) include limitations, usually *pre-determined* by the organization management *before* Project execution, e.g. "predefined budget or any imposed dates or schedule milestones that are used by the customer or performing organization. When a project is performed under contract, contractual provisions will generally be constraints." (PMI, 2008, p. 115)

Risks, on the other hand, are events having a "probability" of occurring that is less than 100 percent and greater than zero probability of occurring. (See Exhibit 1) Risks can be categorized, prioritized, and identified before or after Project execution begins. (PMI, 2008, p. 279-281) Risk events may be viewed as threats or opportunities (Hillson, 2004, p. 17-18)
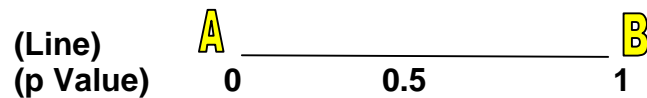
(Line)	A _____ B
(p Value)	0 0.5 1

- ▷ Line AB represents the probability (p) that an event will occur or not occur during a Project, where the points and values on the line are continuous from 0.0 up to 1.0.
- ▷ Points A and B are at the beginning and end of the Line AB, where A = 0.0, B = 1.0, and where: point A represents a 0% probability of occurring; point B represents 100% probability of occurring.
- ▷ Points A and B are points of "certainty."
- ▷ Other probabilities of the event occurring (not including points A or B) are: p > 0.0, and p < 1.0
  - ➤ A Project **Risk** event is the probability of the occurrence of an **"uncertain"** event, hence p >0.0 probability value, and p <1.0 probability value.
  - ➤ A Project **Constraint** event is the **"certainty"** condition of the event either definitely not occurring, or definitely occurring, hence either p = 0.0 probability, or p = 1.0 probability.
  - ➤ Any RISK OR CONSTRAINT event may be analyzed as a **"threat"** or **"opportunity"** for the Project.

EXHIBIT 1: Graphical and Mathematical representation of the differences between Risks and Constraints.

Assumptions generally involve a degree of risk and therefore, have some probability of occurring (greater than 0% and less than 100 percent). (PMI, 2008, p. 287) Assumptions are usually determined before Project execution.

This Paper describes Categories of Project Constraints as positive, useful concepts and views these concepts as helpful to Project success; they are not obstacles to be eliminated, as handcuffs, unnecessary restrictions, or limitations on freedom of action. This view contrasts with the view of Theory of Constraints (TOC) by Eliyahu M. Goldratt (1999) which presents constraints as negative items or events that hinder workflows and production output and, thus, considers them as obstacles to be eliminated, one-by one.

New Definitions: Project Management Constraint Theory and Categories of Constraints

Project Management Constraint** (PMC) **Theory is the identification, definition, categorization, utilization, modification, planning, implementation, and control of Project Constraints. These Project Constraints are sets of rules that ensure positive outcomes or avoid negative outcomes that respectively increase or diminish Project performance and success.

- Definition of Project performance, success, rules, and Constraints may be determined outside of the Project or may be determined by the Project Manager, Team, Stakeholders, or Sponsors.

- Constraints may be grouped into Categories, such as: Constraints to Ensure Positive Outcomes (C-TEPO), Constraints to Avoid Negative Outcomes (C-TANO), and General Constraints (C-G).

Constraints to Ensure Positive Outcomes (C-TEPO) is a special Category of Constraints where *before* Project execution and *prior* to approval of Project changes, the Project Team identifies, defines, communicates, and implements these Constraints in order to ensure positive Project outcomes and add tangible and/or intangible benefits to the Project.

- These Constraints have the state, quality, sense or instruction of being restricted to a given course of action, or inaction, in order to enhance or exploit opportunities and ensure positive outcomes to the Project. These Constraints may be determined by external, organizational, or Project sources.

- This Category of Constraints focuses on enhancing or exploiting these types of Positive Outcomes: Project completion on-time or earlier than scheduled; Project completion at a cost equal to or less than budget; revenue generation for the Project or Sponsor; improved Return on Investment; standardization of Project Methodology and expectations; meeting requirements to the satisfaction of the customer or stakeholder; quality expectations for the resulting product or service; Team ethical behavior; Team safety; Team confidence and focus; job satisfaction and personal growth goals; improved teamwork; respect for Team members, clients, and customers; improved customer relations; and Project success.

  - Example 1. The organization decides to order equipment for the Project only from suppliers who have an excellent track record of on-time or early delivery of orders and agree to payment of significant penalties if not on-time.

➤ Example 2. The Organization's PMO decides to incorporate *Aspirational and Mandatory Standards for Responsibility, Respect, Fairness, and Honesty* from Chapter 2 – 5 of the *PMI Code of Ethics and Professional Conduct® (2007)* into this Project's *C-TEPO*. The decision may originate from the belief that use of such a Code of Ethics by an organization's Project Managers definitely will ensure the success rate of a Project by setting high ethical and positive expectations for behavior of the Project Manager.

The concept of **Constraints to Avoid Negative Outcomes (C-TANO)** was presented by the author as a new Project Management concept of at the 2007 and 2008 PMI World Congresses held in Atlanta and Sydney, respectively. (Kozy, 2008) That Paper includes a sample project that was completed about 2,000 years ago and is available for download at www.KenKozy.com. The category of C-TANO and the category of General Constraints are included here (in Version Two) to show the complete three classifications of PM Constraint Theory.

Constraints to Avoid Negative Outcomes (C-TANO) is a special Category of Constraints where *before* Project execution and *prior* to approval of Project changes, the Project Team identifies, defines, communicates, and implements these Constraints in order to avoid negative Project outcomes and add tangible and/or intangible benefits to the Project.

- These Constraints have the state, quality, sense or instruction of being restricted to a given course of action, or inaction, in order to avoid negative outcomes to the Project. These Constraints may be determined by external, organizational, or Project sources.

- This Category of Constraints focuses on avoiding these types of Negative Outcomes: Project delays, safety hazards; injuries; violations of laws, regulations, contracts, or rules; interference with tasks, argumentation, resistance to change, rejection, and Project failure.

- Generally, this Category of Constraints does not involve relaxing the time, cost, scope, or quality of the Project objectives.

  ➤ Example of C-TANO: the signs (below) found at commercial construction Project sites requiring "Hard Hats" be worn by everyone at that site to prevent tragic head injuries. Other C-TANO include: "Safety Footwear" must be worn on this site; and "Unauthorized Persons" must keep out of this dangerous construction site. (See Exhibit 2: Construction Site Signs in Australia)

EXHIBIT 2: (Left) Construction Site Signs in Australia are examples of C-TANO (Constraints To Avoid Negative Outcomes) to avoid injuries.

EXHIBIT 3: (Right) "To Go" Restaurant Parking Sign in USA is an example of C-TEPO (Constraints To Ensure Positive Outcomes) being used to solve the parking problem and keep positive customer relations utilizing humor.

General Constraints (C-G) is the third Category of identified Constraints.

- These special Constraints are found to have little or no effect on positive or negative Project outcomes but are certain.

- They are applicable restrictions or limitations, determined by external, organizational, or Project sources, that <u>affect the objectives of the project or a process in a meaningful manner.</u>

- They have the quality, or sense of restricting the Project to a given course of action or inaction.

  ➤ Examples of General Constraints (C-G): a schedule constraint "placed on the project schedule that affects when a schedule activity can be scheduled and is usually in the form of fixed imposed dates" (PMI, 2008, p. 429); a fixed price contract; or a new Union work rule.

Tools and Methodology

Tools *to help identify Project Constraints include*: Brainstorming (PMI, 2008, p. 286, p. 428), Root Cause Analysis (PMI, 2008, p. 204, p. 447), "5 Whys" (Liker, 2004), and Fishbone Diagrams (PMI, 2008, p. 287, p. 208-209). This Paper presents a new tool: the Project Management Constraint Template (Exhibit 4).

The Project Team and Stakeholders need to work together to understand the Project and its full scope in order to effectively use these tools to develop such Constraints. A by-product of this process is that the Project Team may improve their level of understanding and buy-in, thus increasing the chances of success of the Project.

Process: Use the column headings in the Template (Exhibit 4: PMC Template):
   A. First, the identification process of Project Constraint Management begins with entries into the first column, *Project Objectives*. Here, list all the objectives of this Project; these are gathered from the Project Charter, Scope and PM Plan documentation, including the Project requirements. This complete list of objectives is necessary before brainstorming for identification and categorization of outcomes and their resultant Constraints in the columns to the right.
   B. Next, define what are the Considerations and Consequences, or what reasons are behind or leading up to each of these objectives (the answers to "Why?" for each entry in Column 1) then, enter the answers into Column 2.
   C. Based upon the information in the first two columns, brainstorm and enter a list of Positive Outcomes Desired (Column 3) or of Negative Outcomes to Avoid (Column 5).
   D. Finally, a list of corresponding Constraints is developed by the Team and entered into their respective Categories in Column 4 or 6.

1) Project Objectives	2) Considerations & Consequences	3) Positive Outcomes Desired	4) Constraints to Ensure Positive Outcomes	5) Negative Outcomes to Avoid	6) Constraints to Avoid Negative Outcomes

Exhibit 4: PMC Template. (Project Management Constraint Table with five columns; add rows as needed.)
See "*Process,*" "*Using the Tools,*" and "*Cautions*" for Guidelines for each cell entry in the Table.

Using the Tools: For each entry in the columns (progressing left to right), use Brainstorming techniques and Root Cause Analysis to determine the underlying reasons and to derive the resulting Constraints. Use the "5 Whys" tool when stuck on an item; for each entry by asking "Why?" five times (once for each answer given). The root cause(s) should become clearer with each answer.

The results of using these tools to identify Constraints in the sample "To Go" Project are shown in Exhibit 6: Project Management Constraints – Identifying Outcomes and Constraints. (If space is limited, related entries in Exhibit 6 can be grouped by color-highlight and tagged as (A), (B), (C), (D), (E), and (F) in order to show their logical relationships and connections across the columns.)

Cautions: Some Team members may be tempted to start by listing all the *obvious* positive or negative outcomes into the PMC Template. However, to jump ahead or start elsewhere must not be allowed. Instead, starting with a complete list of Project Objectives assures that each positive outcome or its opposite will be considered.

This control is necessary in order to complete the Brainstorming process in a logical manner, starting from the column on the left and working toward the columns on the right.

After careful review some outcomes or Constraints developed by the Team may be determined to have less than 100% probability of occurrence; by definition these are Risks, not Constraints. Upon approval of the Team, move those selected Risks to your formal Risk Management analysis. Remember do not include Standard Operating Procedures as Constraints or Risks.

Diagram Tools: Cause/Effect, Ishikawa, and Fishbone Diagrams are thought of as being the same tools. (PMI, 2008, p. 287, p. 208-209) Applying such a diagramming tool makes it easier to graphically display, visualize, understand, and define Constraints by specifying the key goals and outcomes desired, and then determining their causes.
   A. Enter an overall Goal in the box on the far right (See Exhibit 5: Fishbone Diagram Sample).
   B. To the left of the Goal box, identify and enter the desired outcomes that will result in the Goal.
   C. To the left of the outcomes, enter the key contributors and the Constraints that would ensure the positive outcomes (top half of diagram) or would avoid negative outcomes (bottom half of diagram) in order to accomplish the outcomes and overall Goal.
   D. Grouping the Constraints within topic areas such as People, Technology, Environment, Method, Time, Energy, Measurement, and Materials can help the Team brainstorm.
   E. Map the resulting entries to the PMC Template to completion.

When: Identify Constraints *before* Project execution and *prior* to approving Project Changes. The PM Constraints need to be identified *before* the list of Project tasks can be finalized. It is recommended to perform this process at the start of the Team's Risk Management Analysis meeting.

However, once the Project tasks begin to be executed the Team again looks for PM Constraints:

* In Progressive Elaboration (PMI, 2008, p. 7, p. 442), as more details of the PM Plan being executed are discovered, a review of these details and how they affect the Project results are an opportunity to analyze if any additional Constraints or Risks need to be identified. This activity occurs before any changes to the Project Plan are approved and put into execution via the Change

Control System (PMI, 2008, p. 428, p.338, p. 98-99).

- Activation of responses to Project Risk events that actually occur during the Project execution may initiate tasks that result in the need to identify additional Constraints and Risks, or changes to existing ones.

Sample Application of Categories of Constraints to a Modern Project

Background *of a "To Go" Project:* A major trend exists where some global restaurant chains are expanding their businesses by offering "*To Go*" service to their customers. That is, besides the dine-in customers who sit at tables for their dining, other customers who do not have time for dining inside the restaurant can call ahead, order from the same menu, and drive to the same restaurant to pick up the custom prepared food curb-side to take with them to home, office, or their next destination.

Restaurants offering "*To Go*" service usually have been designed to be free-standing buildings, with plenty of parking close to the restaurant building for all of their customers. Therefore, this sample "*To Go*" Project contains both layout design and restaurant service expansion requirements for renovations.

This "*To Go*" offering is not to be confused with fast-food drive-through purchases (e.g. McDonald's), or order pick-ups inside a restaurant (e.g. pizza or Chinese carry-outs). Upscale "*To Go*" restaurants have their same full lunch and dinner menus at their normal prices (e.g. Chili's and Outback Steakhouse chain restaurants). These restaurants offer individual, custom prepared food from their dining menus for "*To Go*" customers.

The "*To Go*" customers may call ahead, fax, or use the internet to place their orders, schedule their pick-up time, and choose if they want to pre-pay via credit card.

When the "*To Go*" customers arrive at the restaurant, they expect to park curb-side near the restaurant where an employee (called a server) sees their parked vehicle, and brings out their appropriately packaged pre-ordered food and bill to the vehicle. If not pre-paid, the customer may pay by cash or by credit card; and then drive away. This exchange should take less than five minutes at the restaurant site.

Benefits*:* "*To Go*" business can mean significant added revenue for these restaurants while their dine-in facilities are not disrupted. They use the same kitchen staff and simply add a phone order-taker/cashier, and a "*To Go*" server to be sure the food is correctly packaged and quickly delivered to the customer's vehicle.

C-TEPO ensuring safety*:* The physical safety of the "*To Go*" servers, cashier, and customers in the parking area is a required goal. If anyone is hit by a vehicle, besides much pain and suffering, the business operation is seriously disrupted. Using

Brainstorming and a Fishbone Diagram (see top half of Exhibit 5), entries for C-TEPO are developed and mapped to entries (A) and (B) of Column 4 in Exhibit 6.

These Constraints require: servers to wear bright yellow reflective vests; the design/construction of a dedicated, close-by door near the curb-side parking; and a marked, signed, and well-lighted parking area by the curb for exclusive use by the servers and "*To Go*" customers.
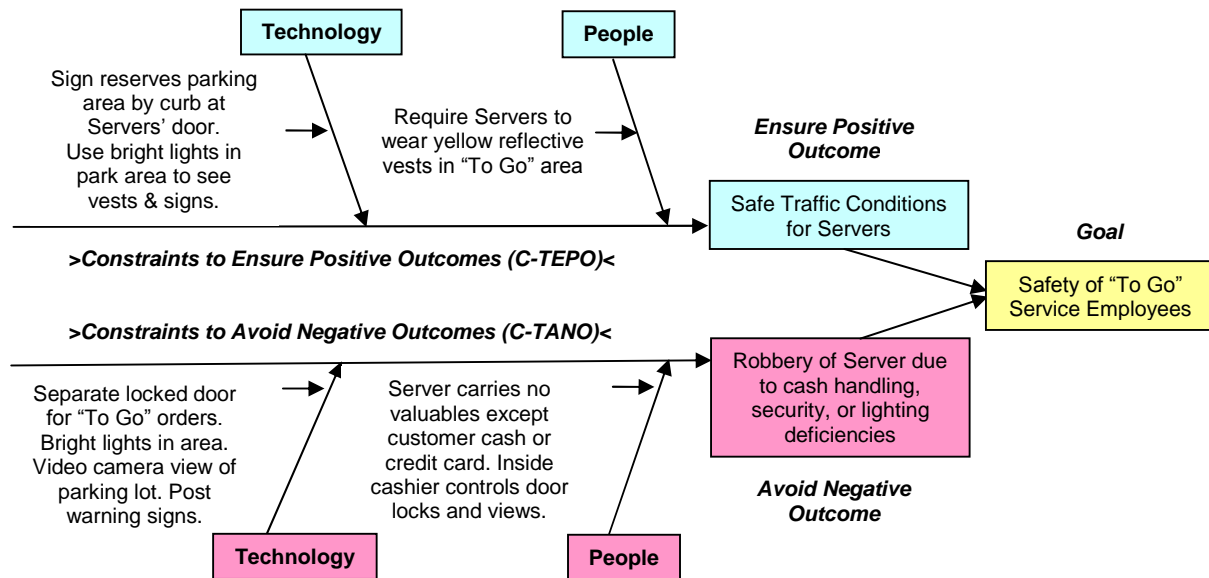
**EXHIBIT 5: Fishbone Diagram Sample –
use of a *Cause/Effect, Ishikawa, Fishbone Diagram*
to derive *Constraints (C-TEPO and C-TANO)***

Parking Challenge: "*To Go*" customers need immediate parking close to the restaurant for quick service. However, dine-in customers also desire to park as close to the restaurant as possible. Especially during inclement weather and on busy nights, they want to park in the closer "*To Go*" reserved parking spots. Certainly, the restaurant does not want to offend or anger their higher revenue-per-person dine-in customers; yet it does not want to lose the extra revenue from the faster turn-over of "*To Go*" customers.

However, if "*To Go*" customers cannot find parking close to the side door, they may wait in a traffic aisle and block the parking lanes, causing an unsafe environment for the server and other customers. Some inconvenienced customers will become dissatisfied and not return.

C-TEPO solves the parking challenge*:* One restaurant chain Team apparently had a creative Brainstorm session and designed innovative signage to ensure a positive outcome of open parking spaces for their "*To Go"* customers.

By the side door and with spot lights shining on these parking spaces, they posted their brand name at the top of their parking signs in big red letters on a white reflective background: "*TO GO* PARKING ONLY – 10 minute limit." Next line: "All others will be CRUSHED AND MELTED." (See Exhibit 3: "To Go" Restaurant Parking Sign)

Obviously, they injected harmless, but clever humor, by suggesting an improbable, but funny image, in the dine-in customer's mind that their vehicle would be crushed and melted if they parked in these reserved spots. Management kept the good will of dine-in and "*To Go"* customers with planning, technology, humor, and effective communication saving these parking spaces exclusively for "*To Go"* service. (See entries (C) and (D) in Exhibit 6.)

C-TANO prevents a tragic event*:* Diagram entries for C-TANO (see bottom half of Exhibit 5) that avoids the negative outcome of a "Robbery of Server" are mapped to the (E) entries found in Exhibit 6. Resulting Constraints (column 6) require the server to carry no cash except from one customer at a time, or the change from cashier.

The new construction design required a well-lighted parking and door area, security cameras with warning signs, and electronic door locks controlled by the cashier or server.

C-TANO also addresses non-safety related Constraints as shown in (F) entries of Exhibit 6. These include budget, construction codes, construction firms, bonds, and use of guards.

Conclusion

In this Paper, Project Constraint Management and a new PM Category of Constraints were defined. A columnar-form Template, tools, methodology, and examples were offered so that Project Managers can apply these positive concepts and creative approaches quickly and easily to new Projects to ensure successful outcomes. (Templates and additional information may be freely downloaded from the author's web site: www.KenKozy.com.)

By definition, Risks are not Constraints. Project Managers must analyze both to assure their Projects will be successful, to produce tangible and/or intangible benefits, and to increase the value of their Project Management.

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Exhibit 6 (Beginning of Table)

1) Project Objectives	2) Considerations & Consequences	3) Positive Outcomes Desired	4) Constraints to Ensure Positive Outcomes	5) Negative Outcomes to Avoid	6) Constraints to Avoid Negative Outcomes
SAMPLE: *To Go* Project (curb-side pick-up of pre-ordered restaurant food). **Design and construction of modifications to existing restaurant building and parking area for added revenue from curb-side pickups – with priority for safety of server employees and customers.** **- Employees: safe from injury from traffic and robbery.** **- *To Go* customers: safe, easy access to adequate parking for pickup of pre-ordered food and to pay their bill.**	**A) Server should be safe from being hit by vehicles in the parking lot.** ------------------------------ **B) The aisles of the parking lot could become jammed with backups if reserved space not available for To Go customers.** ------------------------------ **C) Sufficient parking space availability for the To Go customers and easy parking close-in for their convenience and for the server to quickly and efficiently deliver orders to the vehicles and obtain payment (cash, and credit card).**	**A) The To Go server needs to be safe from traffic accident while delivering food in the parking area.** ------------------------------ **B) To Go customers able to access adequate parking close to the curb-side service.** ------------------------------ **C) Quick turnover for To Go customer spaces (about 5 minutes) who call ahead with sufficient food preparation time, thus increasing customer satisfaction and revenue potential.**	**A1) Close-in curb-side To Go parking area with a separate close-by side door eliminating the exposure of servers to moving traffic.** **A2) Server is required to wear bright yellow reflective vest with ID.** ------------------------------ **B) Reserved To Go parking spaces by a specially decorated, well-lighted entrance keeping a separation between the two customer groups.** ------------------------------ **C) Well lit, ample reserved parking area with cashier/phone inside and quick service.**	**(NOTE: No entries applicable in this column for A, B, C, and D.)**	**(NOTE: No entries applicable in this column for A, B, C, and D.)**

1) Project Objectives	2) Considerations & Consequences	3) Positive Outcomes Desired	4) Constraints to Ensure Positive Outcomes	5) Negative Outcomes to Avoid	6) Constraints to Avoid Negative Outcomes
- Dine-in customers: safe access to adequate parking outside of reserved spaces for *To Go* customers with friendly communication and signage.	D) Dine-in customers need to respect the reserved To Go parking spaces, and not park in them, especially during busy periods when close-in parking is not easily available.	D) Happy, satisfied dine-in and To Go customer parking experiences that encourage repeat business and good word-of-mouth advertising of their location, service, and food.	D1) To Go door needs to be away from main entrance. D2) Large innovative signage reserving sufficient To Go parking spaces easily-identifiable for To Go and dine-in customers. D3) A clear but cordial warning that this space is reserved only for To Go customers.		
Pre-project corporate management decisions: that total costs not exceed x% of estimated annual revenue for restaurant location; use local area construction firms; and adhere to local building codes.	----------------------------- E) To Go customers normally pay, or pre-pay, by credit card, but some pay by cash who then may need change returned.	----------------------------	----------------------------	---------------------------- E) Robbery of server outside or of cashier inside. Safety of employees and deterrents to robbery of employees at the To Go area.	---------------------------- E1) Server carries no cash /credit card except from one customer at a time or their change from cashier. E2) Cashier always stays inside controlling entry through the door. E3) Well-lit parking area with security camera, warning signs & electronic locks controlled by cashier at special entrance.
		(NOTE: No E or F entries applicable in this column.)	(NOTE: No E or F entries applicable in this column.)		

1) Project Objectives	2) Considerations & Consequences	3) Positive Outcomes Desired	4) Constraints to Ensure Positive Outcomes	5) Negative Outcomes to Avoid	6) Constraints to Avoid Negative Outcomes
Traffic or security guards are not to be used due to high cost vs. effectiveness.	F) Pre-set budget, design, and construction limits.			F1) Exceeding Budget limitations of corporate management. F2) Local building code violations and fines. F3) Use of traffic or security guards.	F1) Do not exceed pre-set Budget without pre-approval of corporate management. F2) Use local area construction firms who are knowledgeable of local building codes and bond guarantee of free rework and payment of fines if local codes are violated. F3) Eliminate need for traffic or security guards in design solutions.

EXHIBIT 6: Project Management Constraints – Identifying Outcomes and Constraints.
(*"TO GO"* Restaurant Service Sample)