

# Keeping up with the Joneses:

## A Semester of Learning



## Starring

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# Table of Contents

Table of Contents.....	1
1 Introduction.....	3
2 An Introduction to <i>Indiana Jones and the Last Crusade</i> .....	3
3 The battle between systematic and ad hoc approaches.....	5
3.1 Systematic versus ad hoc in <i>The Last Crusade</i> .....	5
3.2 Systematic versus ad hoc in my experience .....	5
3.3 Closure on systematic and ad hoc approaches.....	8
4 Diaries .....	9
4.1 The Grail Diary.....	9
4.2 A Learning Diary.....	9
5 Perspectives: It's how you look at it.....	12
5.1 X Marks the Spot .....	12
5.2 The Six Thinking Hats .....	13
5.3 Making the familiar strange and the strange familiar.....	13
6 The system view: Understanding objectives .....	13
6.1 Mission objectives in <i>The Last Crusade</i> .....	13
6.2 Mission objectives in engineering design.....	14
7 Duty to society and the public good .....	15
7.1 Indiana's role in the greater good .....	15
7.2 Corporate role in society.....	15
8 A Leap of Faith.....	16
8.1 Indiana's Leap of Faith.....	16
8.2 Leaps of faith in engineering design.....	16
9 Communication.....	17
9.1 Language Problems .....	17
9.2 How you say it matters, too .....	18
10 Did I find the grail?.....	21
10.1 Learning to Keep Learning .....	21
10.2 My A0 Goals.....	22
11 Where is the next adventure?.....	23
References.....	24

# 1 Introduction

As a participant in ME 6101 this semester, I have learned many things. Some are small lessons, and some are big. Some are about engineering design, and some are about me. In this paper, I try to illustrate some of these lessons by making an extended analogy.

I have chosen to use the movie *Indiana Jones and the Last Crusade* as my analogy. I have watched this movie more than any other movie, and I still find it exhilarating and hilarious. For the most part, I will be relating particular scenes of the movie to particular lessons that I have learned by completing ME 6101. I try to avoid any direct analogies with the *Crusade* and the search for the *Holy Grail*. ME 6101 was not a war waged for the Holy Land, and searches for the holy grail of anything are often misguided.

I will nevertheless draw one analogy between ME 6101 and the *Holy Grail*. The legend of the Holy Grail is that anyone who drinks from it will be granted eternal life. The holy grail of ME 6101 is attained when a student learns to keep learning. That is the primary accomplishment that lives on past ME 6101 and can help a student attain unlimited heights in the future. I assess my quest for the holy grail of ME 6101 in Section 10.

My original idea for an analogy was based on the American West and frontier life. As this idea was in part fostered by Steve Rekuc's ME 6101 and ME 6102 SLEs, I decided to read his ME 6102 SLE. I was unable to draw many new analogies from his, and as part of the point of writing the SLE is to exercise creativity, I sought a different analogy.

## 2 An Introduction to *Indiana Jones and the Last Crusade*

*Indiana Jones and the Last Crusade* is the third movie in the *Indiana Jones* trilogy. The basic plot is that Indiana Jones sets out to find his father, who went missing while searching for information on the location of the Holy Grail—which according to legend caught the blood of Christ on the cross, and can give eternal life to anyone who drinks from it. Unfortunately for the Joneses, the Nazis are also after the grail, and as one character states, no one is to be trusted.

Henry Jones has dedicated his life to researching the grail. His all consuming passion and desire to win a race against evil has caused him to have a rocky relationship with his son, and caused his wife to hide her deadly illness from him. Indiana Jones is an adventurer. His full-time job as an archaeology professor is supplemented by his quests around the world to hunt down expensive and powerful treasures. In his mind, such treasures like the Cross of Coronado “belong in a museum.”

Indiana is used to high adventure and danger. Henry can't get used to the idea that “Those people are trying to kill us!” The two rarely see eye to eye, as Indiana doesn't understand his father's motivation, and Henry doesn't understand that his son wants to be

called “Indiana” instead of “Junior.” The movie is clearly an adventure movie first, but the quest for the Grail does not preclude the Joneses learning about themselves and each other. In the end, the two can succeed only if they work together.

If you are not familiar with the movie, I suggest reading the following two summaries. The official Indiana Jones website [[indianajones.com](http://indianajones.com) 2003] advertises the movie as follows:

“I told you ... don’t call me Junior!”

The year is 1938. Twenty-six years ago, young Indiana Jones was thwarted in an attempt to retrieve the legendary Cross of Coronado from the hands of robbers. But an older, wiser and stronger Indy has finally returned the jewel encrusted Cross of Coronado to his boss, Marcus Brody.

Almost as soon as he arrives back at his quiet, New England college, though, Indy is whisked away by representatives of multi-millionaire Walter Donovan, who has unearthed a mysterious stone. Indy recognizes it as the first of three long-buried markers that reveal the location of the Holy Grail itself.

But the man who found the stone tablet has gone missing: Dr. Henry Jones, Indy’s long-estranged father and the world’s foremost Grail expert. Journeying to Venice, Indy meets Dr. Elsa Schneider, Donovan’s colleague, who helps him track down his father.

But they are being followed by the Brotherhood of the Cruciform Sword, whose members have vowed to protect the Grail at any cost even Indy and Elsa’s lives. One of these warriors reveals that Indy’s father is being held in the imposing Brunwald Castle in Austria. What Indy doesn’t know is that the castle is actually a Nazi stronghold and that Elsa is a Nazi double-agent who’s also working for the duplicitous American Donovan.

Dr. Jones Sr. and Dr. Jones Jr. find themselves chased through the streets of Berlin, through the skies above Germany and through the deserts of Turkey. Along with Brody and old friend Sallah, they finally locate the Grail’s resting place but the Nazis have beaten them there. Determined to force Indy to retrieve the Grail, Donovan shoots Indy’s father, who collapses to the floor. Hesitantly, Indy enters the temple ...

The following summary of the movie is taken from [fye.com](http://fye.com) (2003).

The third installment in the widely beloved Spielberg/Lucas Indiana Jones saga begins with an introduction to a younger Indy (played by the late River Phoenix), who, through a fast-paced prologue, gives the audience insight into the roots of his taste for adventure, fear of snakes, and dogged determination to take historical artifacts out of the hands of bad guys and into the museums in which they belong. A grown-up Indy (Harrison Ford) reveals himself shortly afterward in a familiar classroom scene, teaching archeology to a disproportionate number of starry-eyed female college students in 1938. Once again, however, Mr. Jones is drawn away from his day job after an art collector (Julian Glover) approaches him with a proposition to find the much sought after Holy Grail. Circumstances reveal that there was another avid archeologist in search of the famed cup—Indiana Jones’ father, Dr. Henry Jones (Sean Connery) -- who had recently disappeared during his efforts. The junior and senior members of the Jones family find themselves in a series of tough situations in locales ranging from Venice to the most treacherous spots in the Middle East. Complicating the situation further is the presence of Elsa (Alison Doody), a beautiful and intelligent woman with one fatal flaw: she’s an undercover Nazi agent. The search for the grail is a dangerous quest, and its discovery may prove fatal to those who seek it for personal gain.

# 3 The battle between systematic and ad hoc approaches

One of the things I struggled to accept in ME 6101 was that a systematic approach will support and not hinder creativity. It seemed to me that a systematic approach would stifle creativity and therefore limit the design process. By the end of the course, I learned that a systematic approach can direct thinking and actually increase the likelihood that a successful idea is found.

## 3.1 Systematic versus ad hoc in *The Last Crusade*

Henry Jones is a diligent scholar who researches and records everything that might be valuable. Indiana is an action hero who graces the silver screen because of his ability to succeed in an ad hoc manner. In *The Last Crusade*, both personalities have their place. Indiana and the Nazis are convinced that once they know where the grail is, they can go get it. Henry knows better; they need to know what to do once they get to the temple that holds the grail.

[INDY glances back and smiles, but the smile fades as he looks forward again to see a sign at a CROSSROAD. Arrows pointing in opposite directions indicate the way to BERLIN or VENEDIG. Indy starts down the road marked VENEDIG.]

HENRY: Stop! Stop!

[The motorbike skids to a stop.]

HENRY: You're going the wrong Way! We have to get to Berlin!

INDY: [pointing towards Venedig] Brody's this way.

HENRY: My Diary's in Berlin.

INDY: You don't need the Diary, Dad. Marcus [Brody] has the map [to the Grail].

HENRY: There is more in the Diary than just the map.

INDY: All right Dad-tell me.

HENRY: Well, he who finds the Grail must face the final challenge.

INDY: What final challenge?

HENRY: Three devices of such lethal cunning.

INDY: Booby traps?

HENRY: Oh, yes. But I found the clues that will safely take us through, in the Chronicles of St. Anselm.

In addition to having *systematically* considered and uncovered the secrets of the grail, Henry has planned *strategically*. He wants to know what to do at each step of the way, because otherwise there is a high likelihood of failure. The same is true of engineering design. A systematic approach will increase the chances for success, although I was reluctant to accept this. Indiana rushes forward, assuming he knows the next step, but since he doesn't have a plan, he often skips something important.

## 3.2 Systematic versus ad hoc in my experience

In my assignment 1B, I stated the main message of P&B as the following:

The main goal of an engineering design methodology should be to guide the designers down the correct path. Without a systematic approach, it is unlikely that designers will choose the correct path, and without the correct path, it is unlikely that the correct solution will be found.

Through my work and reflection during ME 6101, I have learned to accept this view. In addition to learning how a systematic process can be useful, I have also learned about myself and my reasons for shying away from systematic approaches. By identifying these reasons, I was able to challenge them, and hopefully I will eventually reject them completely.

### 3.2.1 The American Hero: Champion of the ad-hoc

American culture seems to raise a particular personality to hero status. The image of this hero is not the organized, systematic engineering nerd. Conversely, our culture champions the ad hoc. People seem to idolize quick thinkers—people who think on their feet, respond quickly, and succeed.

For example, one of the most popular American football players is Atlanta Falcons' quarterback Michael Vick. Michael Vick is popular because of his ability to scramble (run) around and avoid the defense. Traditionally, the quarterback's role is to run the offense and hand-off or throw the ball. Michael Vick does this, too, but fans are attracted by his ability to make something happen when a designed play breaks down. He is agile—mentally and physically. What he does is exciting; his strengths are magnified because they are clearest under adversity and at times of panic.

Another example is from basketball. Fans tend to prefer and celebrate a “high octane” offense that scores off turnovers and fast breaks. During these fast breaks, it is a player's natural talents—especially coordination—that dictate his or her success.

An alternative style of offense is called the Princeton offense. The Princeton offense advocates a philosophy captured in the book title “The Smart Take from the Strong” (Carril 1997). The general idea is that a set, deliberate, systematic offensive scheme is better at breaking down a defense than an ad hoc, fast break offense is, because if the fast break doesn't happen, then a fast break team is out of luck. The Princeton offense emphasizes working as a team and using the entire court to play offense. Critics of the Princeton offense usually claim that it is boring and doesn't take enough skill. Proponents say that it works, and more and more teams are adopting variants of the Princeton offense.

### 3.2.2 Personal insecurities

So why have I preferred to embrace the fast break recipe for success? Throughout my life, I have tended to want to prove that I can do things that fall outside of my natural talents. For example, in the past I tried very hard to succeed at sports, and was very frustrated when I failed. My tendency to try things outside of my talents was motivated by two things. The first was a general competitiveness to my nature, and the second was a desire to be accepted, which first arose during a very unhappy first two years of middle school.

The combination of my desire to be accepted with the prevailing culture that I discussed in the previous Section 3.2.1 has led me to prefer ad hoc approaches to things. I accepted the societal view of ad hoc showing more talent than systematic. It seemed to me that an

ad hoc process showed more creativity, and given my obvious analytical abilities, I wanted to show that I could be creative too, even though my creative abilities have been more difficult to cultivate.

### 3.2.3 If it ain't broke, don't fix it

In my experiences, there has never been a compelling reason to reject an ad hoc approach in favor of a systemic approach. I pretty much always succeeded with the ad hoc approach because time after time, my raw abilities were sufficient to not only get by but to excel.

There have been times when I adopted a systematic approach. During my internships, I assumed that things would be much more difficult than in school. I also thought that failure would be more costly. I therefore tried to plan my work more than ever before. As one example, I consider my presentations, including those in college. At first, I would outline and plan the presentations extensively, and I would rehearse for several hours. After doing this a few times, I began to become complacent, because everything always went well; I felt good about the presentation and I received exclusively positive feedback. This changed with a presentation I gave this year, which was close to an unmitigated failure. Only now am I recognizing that there may be something broken.

As I have tried to organize a plan of study and research path for a Ph.D., I have begun to realize that I will not be able to complete a Ph.D. without a systematic approach. The task is just too broad, and there are too many wrong paths to take.

### 3.2.4 How I learned to appreciate the systematic approach

My increasing appreciation for a systematic design approach is the best of example of me incrementally learning during ME 6101. In my A1A, I noted that

I completed all of Part 1 in one day, and by the end, my patience for reflecting was diminishing, and my descriptions followed the section introductions more closely than I would have liked. Even after taking several breaks, I could not regain the level of attention I had in the morning. Perhaps in the future I will have to split my work such that I work on two things during the course of the day.

As I wrote in my portfolio summary

Because I suffered from mental or attentive fatigue in trying to complete this assignment, I learned that I may need to break my tasks into subtasks. Extending this, scheduling has a role in my life as well as in engineering design. Now that I have set my sights on a Ph.D. and have more and less inherently structured tasks to do in less time, I need to take a systematic approach to my own work and schedule better. It isn't just *having* the time to do something; it is having it in the *right blocks*. Eight hours is probably worth more in 2-3 chunks than all at once. I believe this is even more true in groups, when people can get on each others nerves.

In A7 I recognized, "One way management could ensure quality designs while trying to keep costs low is to adopt a systematic design methodology such as robust design and risk based design. If engineers follow the steps of the method properly, they will consider things in the correct order."

In LE 1 I abstracted from the Three Little Pigs Game:

Our failure to consider detail design taught me a valuable lesson about budgeting—it is necessary and useful even for small tasks. By forming a schedule, or time budget, the necessary tasks can be outlined explicitly. This should ensure that crucial steps are not skipped. In general, I have learned that a structured approach is valuable.

My LE5 is recognition of my acceptance of the value of a systematic approach. As I write in my portfolio summary:

Much as a systematic approach to design can help organize and improve product design, my outline enabled a systematic approach to answering the Q4S because I could write to specific purposes. I recognize the difference and value of this outline most clearly when I compare my A2Q4S with my project submission. The project was planned using the P&B approach, but we did not outline the project report until about three weeks ago, which was too late. In one case, I have learned from my success (using the outline for my A2Q4S) and in another I have learned from my failure (project report).

These activities, and more importantly my reflection on them, have helped me to recognize the value of a systematic approach, despite my initial bias against such an approach.

### 3.3 Closure on systematic and ad hoc approaches

There is tension between order and randomness. They are opposite ends of a spectrum. In popular culture, order is often portrayed as bad. For example, the order of *1984* or *A Brave New World* is unacceptable, as were the marching legions of Nazi soldiers in World War II. At the other end, randomness is often portrayed as good. For example, the Continental Army used a chaotic form of hit and run warfare to defeat the systematic British in the American Revolution, the American cowboy is a heroic lasting symbol of freedom as he roams the plains as he pleases, and the soaring bald eagle is a majestic symbol of freedom from all bounds. However, chaos can also be bad, such as angry lynch mobs, rioting, and looting.

The lesson to be learned is that there can be good and bad in both extremes, but under different circumstances. In engineering design, order is better, but to be an action hero and popular icon, you need to be a lucky, ad hoc success like Indiana Jones.

The most successful individuals will probably be good at both. Indiana Jones only could reach the grail because of the clues his father's systematic research had uncovered *and* because of his fast thinking. A systematic approach will supply designers with the scaffolding to succeed, but there will still be room and need for creativity and ad hoc solutions because things don't always go as planned. As I noted in my LE1, "Those who flourish are able to anticipate, react, and adapt quickly." The goal of a systematic approach is to reduce the reliance on these skills and increase the likelihood of success.

## 4 Diaries

Farrokh stressed to the class that ME 6101 is a learning opportunity, especially an opportunity to learn how to keep learning. With the number of possible lessons that I could learn in ME 6101, how will I ever recognize and remember them all?

### 4.1 The Grail Diary

Henry Jones kept a diary of his lifetime of work in tracking down the Holy Grail. One purpose of this grail was to help him remember what he learned. For example, when discussing the final challenge that he who finds the grail must face, Indy and Henry have the following exchange:

HENRY: Oh, yes. But I found the clues that will safely take us through, in the Chronicles of St. Anselm.

INDY: But what are they? Can't you remember?

HENRY: I wrote them down in my Diary so that I wouldn't have to remember.

Humans, even one of the Joneses, can't remember everything. Henry used his diary as a tool to augment his memory.

I argue that by keeping the diary, Henry also better understood what he was studying. For example, the Grail Diary contains a meticulously detailed sketch of a stained glass window from the library where Indiana finds the Knight's tomb. I speculate that by detailing the window, Henry's attention was focused on the Roman numerals across the bottom. These numerals eventually pointed Indiana to the tomb. The act of keeping the diary helped Henry recognize important details, helped him remember vital information, and communicated it to others.

### 4.2 A Learning Diary

Despite their title, I did not use my Learning Essays as a documentation of my learning. Certainly I used them as a mechanism to learn, and I directed my learning towards my goals and answering the Q4S. However, I did not use them as a learning diary.

I began to learn the importance of a learning diary while completing my outline to my A2Q4S in LE5. I explored this lesson in LE6, where I wrote:

...as I examined what material I have already prepared and started to work the tasks I had scheduled [in LE5], I realized that I have not taken a very serious look at what I've done so far. This is a serious problem for several reasons.

When I do not explicitly revisit and reread my past work, I cannot carry forward many of the lessons learned. This decreases the value of the original works because they are stuck in the past. By rereading and re-relating them to my experiences, I am bringing them into the present and then I can once again use them as a spring board towards the future.

When I review my previous work now, I am also facilitating my completion of the semester learning essay. I can better tell the story of my journey of learning if I continue to update my notes and maps along the way instead of trying to recreate them all at end of the journey.

Unfortunately, I did not carry this lesson forward during the rest of the course, despite the following recognition of value at the end of the essay:

I have identified and consolidated some unanswered questions and some excellent passages that I can use to both formulate and then answer my question for the semester. Certain ideas have also been rekindled in my mind, and other re-settled, because I see that I already addressed them. I think that this work will help me assess my own work at the end of the course, and to write a semester learning essay.

I have also added value to my previous work in several places by responding to Farrokh's comments, especially where he suggested that I draw a lesson from what I'd written. In writing this paper I was able to use my better understanding on my tasks and P&B to extract more form my previous work.

I believe that a learning diary would have been as useful to me in ME 6101 as Henry's Grail Diary was to himself and Indiana. As the semester progressed, I began to summarize the value that I created by writing my learning essays, but I did not emphasize what I *learned* by completing the essay. I did nothing to record what I learned from lectures and other classroom activities. This was a failure on my part for the following reasons.

Farrokh presented the notion of a learning square in ME 6101. I have reproduced this here in Figure 2 in the first person, making it my learning square. Keeping a learning diary can help me in several ways.

Competent	Incompetent	
Know I know	Know I don't know	Conscious
Don't know I know	Don't know I don't know	Unconscious

**Figure 1: The Learning Square**

In my A1B, I noted that, "Apparently reflection takes time and can happen subconsciously as well as consciously." If I don't analyze and record the lessons that I learn, they will probably remain unconscious, falling into the "don't know I know" square. By consciously considering my lessons learned, I make them conscious, moving them into the "know I know" square. I can consciously apply these lessons in the future, leveraging to new things and adding value to them.

In addition to the process of originally moving these lessons into the "know I know" square, the diary can help me keep things there. Due to limitations of the human mind, lessons are forgotten. I noted my limited ability to consider everything twice in A1B. For example, "It was hard to exact where a specific though or understanding originated.

This ability will be necessary to properly acknowledge the work of other people.” If I have captured my lessons in a diary, I can highlight and review the most important ones. This pulls lessons back into the “know I know” square, and helps me to identify from where, or in what activity, I learned something.

I also wrote in A1B that, “I had to iterate to complete the deep reading, unable to keep all the questions (which can be thought of as requirements or goals) in mind from the beginning.” In this case, the assignment provided the scaffolding of things that I needed to consider. In the future, I will need to provide my own scaffolding.

I believe that keeping a learning diary can also help me identify things that I don’t know. For example, in *The Last Crusade*, Henry created a map marking the location of the grail. He pieced this map together from clues, but the map had no names. By recording this map in his diary, he learned what he didn’t know: the name of a key city, which Indiana finds in the Knight’s tomb: Alexandretta. Therefore, the practice of keeping a learning diary can help me move from the “don’t know I don’t know” square into the “know I don’t know” square, which is the only place that learning can begin.

Put another way, the completion of a learning diary achieves a similar effect in learning that the P&B process achieves in engineering design. According to Pahl and Beitz, “Systematic procedures merely try to steer the efforts of designers from unconscious into conscious and more purposeful paths” (Pahl and Beitz 1996). The act of creating a learning diary steers learning efforts into conscious paths.

Once in the “know I don’t know” square, learning can begin. I can use activities such as deep reading and writing learning essays to help me move to the competent half of the learning square. The ORA (observe, reflect, articulate process) is a very valuable tool, and it definitely helps me to move from the incompetent half to the competent half.

Without the use of a learning diary, I could easily move into the “don’t know I know” square instead of the “know I know” square. In Figure 2, I have modified the learning square to show the role of different activities in learning. In summary, the Learning Diary helps to move knowledge from the unconscious to the conscious, and the learning essays help to create knowledge, and move me from incompetent to competent.

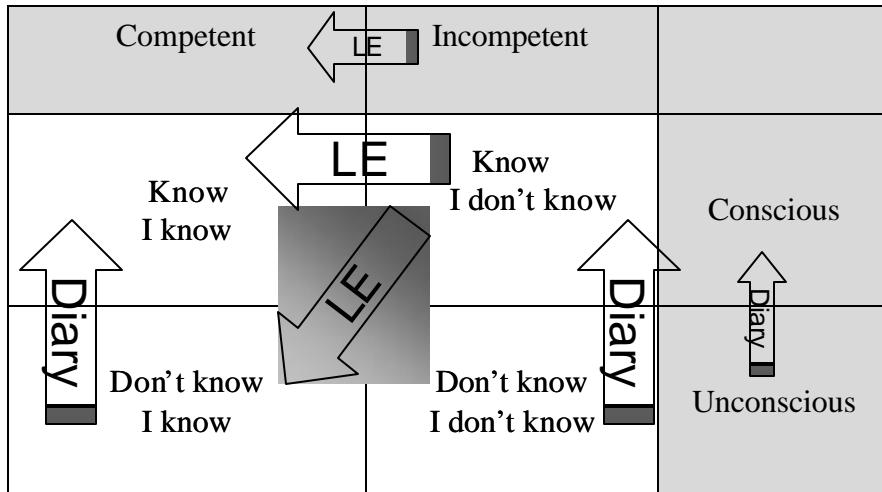


Figure 2: The role of a learning diary and learning essays in learning

## 5 Perspectives: It's how you look at it

In A1B, I noted that, “Sometimes it was necessary to try to adopt a particular belief and see how far I could get with it; this was fruitful but clouded what I was really thinking. It seems that I have developed a skill for adopting a perspective and running with it, without really understanding how committed to that perspective I am.” From the Little Pigs Game and my reflection in LE1, I learned that, “multiple perspectives are valuable, especially if the perspectives come from people with different areas of expertise.”

Engineering design is about solving problems by finding ideas and making decisions. In order to find good solutions and make good decisions, an individual must be able to employ multiple perspectives. It is therefore important for individuals and teams to have a diversity of the mind.

### 5.1 X Marks the Spot

Indiana travels to Italy to a library where his father was last seen. Knowing that his father was in the process researching the tomb of one of the Grail Knights, Indiana assumed that his father was doing research at the library. However, he suddenly has another thought:

INDY: Dad wasn't looking for a book about the Knight's Tomb... he was looking for the Tomb itself!  
[ELSA wears a blank expression.]

INDY: Don't you get it? The Tomb is somewhere in the library! You said yourself it used to be a church! Look.

As Indiana tries to match numbers on a window to other locations in the library, he can't find the second Roman numeral for ten.

INDY: And ten. Now where's the ten? Look around for the ten.

[INDY walks past aisles of book-lined shelves. He stops, turns, then looks down.]

INDY: Three, seven and ten.

[He climbs a spiral staircase leading up to a LOFT and looks down at BRODY and ELSA. The floor beneath their feet is an elaborate tile design containing a huge "X"-visible only from this higher angle.]

INDY: Ten. [wryly; to himself] "X" marks the spot.

Indiana had to change his perspective twice to find the entrance to the tomb—once mentally and once physically. Engineers will also have to learn to employ diverse perspectives in their quest for superior designs.

## 5.2 The Six Thinking Hats

The Six Thinking Hats is an attention directing method in which people are asked to adopt a particular way of thinking, or six particular perspectives. There are six “colors” of hats, and each color is a set of directions on how to think. The notion of hats that can be put on and taken off is essential, because a role should not be filled by the same individual all the time. The six thinking hats are not about pigeon-holing people into roles, but about the opposite—broadening perspectives.

I really learned to appreciate this attention directing tool, and it helped to open my mind to other tools. It also helped me to understand the notion of bounded rationality. It really is impossible to consider everything at once. By confining thinking to some region, direction, or quality, more progress can be made.

I learned to apply this when I considered four aspects of the year 2020 while writing my LE2. Prior to this approach, the task of defining a vision for 2020 seemed too daunting. When I focused on specific aspects of 2020, I suddenly had a stream of ideas. Focusing one’s thinking on one topic or way of thinking is not the only way to reach a new perspective.

## 5.3 Making the familiar strange and the strange familiar

By completing my LE2, I began to learn how to apply a different technique for changing perspectives; I compared the advance of technology and engineering design to the expansion and settlement of the American geographic frontier. Through this analogy, I developed an appreciation for some of the challenges in engineering design and the advance of technology. I was able to abstract frontier lessons which I translated into design principles.

# 6 The system view: Understanding objectives

I would like to make two points here. First, if an individual has no clear objectives or goals, then, as Farrokh has presented in lecture, it doesn’t matter in which direction one goes, he or she will still never get there. Second, if the members of a team don’t share the same vision, there will be problems. As teams are omnipresent in engineering design, there must be a means to keep them on the same page.

## 6.1 Mission objectives in The Last Crusade

When Indiana set out for Europe, he had a clear goal: he wanted to find and rescue his father. He soon found his father, although the rescue was a bit more challenging. Unfortunately, Indiana did not understand his real role in his father-son team. Soon after

Indy finds his father, the Nazis find and capture Indy and Henry. Then the following occurs:

S.S. OFFICER: [to INDY] You have the Diary in your pocket.

[HENRY laughs genuinely, believing himself to be laughing at the expense of the S.S. OFFICER.]

HENRY: You dolt! Do you think that my son would be that stupid that he would bring my Diary all the way back here?

[At which point an awful thought strikes HENRY.]

HENRY: You didn't, did you? [pause] You didn't bring it, did you?

INDY: Well, uh...

HENRY: You did!!...I should have mailed it to the Marx Brothers.

INDY: Will you take it easy....!

HENRY: Take it easy?! Why do you think I sent it home in the first place? [points towards the NAZIS] So it wouldn't fall into their

hands!!

INDY: I came here to save you.

HENRY: Oh yeah? And who's gonna come to save you, Junior??

Indiana clearly failed to understand the significance of his mission or the details of it. At this point, he has failed in what should have been his number one objective, from his father's perspective. Indiana's failure to understand his father's mission is illustrated again later:

HENRY: The quest for the Grail is not archaeology. It's a race against evil. If it is captured by the Nazis, the armies of darkness will march all over the face of the earth. Do you understand me?

INDY: This is an obsession Dad. I never understood it. Never. Neither did Mom.

HENRY: Oh yes, she did. Only too well. Unfortunately she kept her illness from me until all I could do was mourn her.

For years, Henry had failed to convey to his son the importance of his work. His wife understood it enough to withhold her illness from him so that he would continue his work. She was on the same page with Henry, but Indiana is not.

## 6.2 Mission objectives in engineering design

In ME 6101, I learned that teams need to understand their role in the larger project. If they lose sight of the system objectives, or if they misunderstand the system objectives, the entire design will fail. This is true at two levels. At the lowest level, each human must understand his or her role on their team. At the higher level, members of each team must understand how that team fits into the larger organization.

By working on the team project, I learned that the management planning tools can help members of a team stay on the same page. Leyla and I achieved this by creating a team contract and schedule. Both of these began augmentations for the year 2020 that we believe will become even more important than today; although the role of teams is prominent today, there will be more challenges in the future when teams are geographically distributed.

Tightly coupled with the need to understand the mission objectives is understanding the requirements. In my LE1 I related my learning experience from the Three Little Pigs game. I noted the important in understand the goal as, "the failure of most teams to concentrate on clarifying the task probably illustrated a fundamental flaw in our approach

to design. The groups may have chosen a goal and heading for it, but it was not necessarily the correct goal.”

In my LE1 I state that:

I learned that no matter how clear the task sounds, implicit assumptions (such as the definition of a house) can lead to design failure and that failure to revisit the task description can lead to even the most obvious requirements being overlooked.

....

I learned that it is important to ponder consciously and explicitly what the stakeholder could *possibly* mean, and then seek clarification, rather than just implicitly assume what they *probably* mean.

Without fully understanding the stakeholders’ true requirements, it is impossible to understand the mission objectives. Even if a systematic path is followed to the perceived goal, it does little good if the perceived goal is incorrect.

## 7 Duty to society and the public good

This builds off of my previous lesson. It isn’t enough to know your role in an explicit team; you also have to understand your role in society at large. A shared vision and philosophy can unite individuals in a common purpose, which will help mind teams together.

### 7.1 Indiana’s role in the greater good

On several occasions Indiana loses sight of his responsibility to society. In the earlier example when he brings the diary back to the Nazis, he put his personal concern—rescuing his father—ahead of saving the world from Nazi immortality. At another point, he risks both his father’s life and the fate of society to save a single woman who he is in love with. Depending on an individual’s values and ethics, his actions could be considered good or bad, but my assumption is that the good of society as a whole should be considered, in which case he has failed. In the end, it is Indiana’s rescue of *society* that makes him a hero to the audience.

### 7.2 Corporate role in society

In ME 6101, I learned that a company must have a philosophy of operation. Without an established code of ethics, there will be ambiguity in what courses of actions to pursue, even if decision makers start from identical premises. There is also a need to agree on some values, such as the importance of environmentally conscious design. The shared philosophy will help for a community across geographic and departmental boundaries. I also learned that I would feel more content working for a company with a clearly stated purpose in serving society. I wasn’t sure about this before trying to articulate a philosophy for my company, especially considering how dissatisfied I was working for MITRE. By working for a company that has a clear dedication to serving society, I can picture myself as a small hero. There are certainly ways to give back to society outside of work, but it would be nice to be able to do it at work, too.

# 8 A Leap of Faith

There are times in life, religion, and engineering design when something cannot be known with certainty. There are other times when the cost of reducing uncertainty is more than the reduction of uncertainty is worth. In both cases, the designer is left with a gap in knowledge. In these cases, the only thing to do is to make a leap of faith.

## 8.1 Indiana's Leap of Faith

There is a dramatic scene near the end of the movie when Indiana Jones is trying to complete the final challenge and retrieve the Grail.

[INDY stands in a small opening, just small enough for his shoulders to squeeze through and beyond that a 100 foot drop to the rocks below and 100 feet across, nothing but a rough, stony cliff wall. He can see nowhere to cross. He looks again to the Grail Diary.]

INDY: [reading] "The path of flood. Only in the leap from the lion's head will he prove his worth."

[INDY looks around and then he notices that inscribed into the rock above his head is the head of a lion.]

INDY: Impossible! Nobody can jump this!

[INDY looks down into the Diary and tortures over what it is asking him to do; cut some lines]

INDY: [realizing] It's... a leap of faith.

HENRY: [calls to his son] You must believe, boy. You must...believe.

Indiana makes the leap of faith and succeeds, as a hidden pillar of stone catches his feet, and he can walk across the abyss. Had he not attempted his leap of faith, his quest to save his father and to find the grail would have failed.

## 8.2 Leaps of faith in engineering design

I really did not learn this lesson directly in ME 6101, but I did learn it this semester. I have known for a while that theories and models can ever be completely validated; they can only be proven incorrect. However, I never thought of the adoption of a theory or the use of a model as a leap of faith until several discussions that my research group has had this semester. The motivation for our discussion was Hazelrigg's presentation at DETC 2003 (Hazelrigg 2003).

Given that it will always be necessary to make a leap of faith when using a model, I have to ask what the role of validation is. Through the analogy with a leap of faith, I learned that the role of validation is to build credibility in the model. In order to be willing to make a leap of faith, there has to be something you have faith in—in this case the model developers. Before an engineer should be willing to trust the model, they must build up faith that the model is correct enough for his purposes, that is given his input parameters and context of use, including the alignment of his assumptions with the assumptions used to simplify reality into the model. If the context and assumptions inherent in a model are not clear, then an engineer should not have any faith in the model alone. Leaps of faith also need to occur when design decisions need to be made without all the desired knowledge.

# 9 Communication

Communication plays a large role in anything involving humans. Humans do not naturally think alike all the time, and they certainly don't share the same experiences and knowledge. This became painfully aware to be during the Three Little Pigs game. Communication is the means through which humans can collaborate and share knowledge. Since design requires the application of knowledge, effective design requires effective communication, and as I noted in my LE1, "good communication requires a standard language."

## 9.1 Language Problems

The most obvious obstacle to communication is the lack of a shared language. This can lead to the complete inability to communicate, or to serious misunderstandings.

### 9.1.1 Language problems in *The Last Crusade*

There are two clear instances of language problems in *The Last Crusade*. The first is the obvious lack of a shared spoken language:

[CITY OF ISKENDERUN. BRODY disembarks from the train along with the other PASSENGERS, a cross-section of ARABS and TURKS. We wanders looking very nervous and lost through a gauntlet of street vendors]

BRODY: Does anyone here speak English? Or even ancient Greek?

Marcus Brody is unable to communicate with the local population. Anyone who has traveled in a country where he or she does not speak the local language has probably shared Brody's feeling of helplessness.

There is another example in *The Last Crusade* that is more subtle and at the same time more related to communication problems in engineering design. As part of the final challenge, Indiana has to walk over a grid of letters on the cave floor.

[INDY holding the Grail Diary, reading once again, his fedora now covered in cobwebs.]

INDY:"The second challenge is the Word of God. Only in the footsteps of God will he proceed." [to himself] The Word of God... The Word of...

[INDY pulls away some cobwebs to reveal a cobblestone path. Each cobble is engraved with a letter.]

INDY: "Proceed in the footsteps of the Word."

....

INDY: The Name of God... Jehovah!

....

INDY: "J."

[INDY takes a step and immediately a stone breaks away and INDY falls up to his hip—his leg stuck through the hold where the stone once was.]

....

[INDY grunts as he pulls himself from the hole, the Grail Diary in his hand.]

INDY: In Latin, "Jehovah" starts with an "I." "I"...

[Now we SEE each letter on the stones as INDY carefully walks forward.

DONOVAN and ELSA follow in his footsteps.]

INDY:"E"... "H"... "O"... "V"... "A"...

Indiana literally fell for a slight difference in syntax. He did not know what language the word was written in, and his lack of knowledge nearly cost him his life.

### 9.1.2 Language problems in Engineering Design

The first example—not sharing the same language—is a superficial problem. It is obvious that people with no common language will have major problems communicating. What is more interesting is the relationship between the Jehova example and engineering design.

Language problems occur not just across cultures and countries, but also across disciplines. For example, consider Indiana’s confusion of the letters ‘j’ and ‘i’. These letters frequently take on different meanings in engineering. For example, in mechanical engineering, ‘i’ is a symbol that stands for the square root of negative one. Given the equation  $V=iR$  a mechanical engineer should conclude that  $V$  is equal to  $R$  times the square root of negative one. An electrical engineer will instead see  $V=iR$  as voltage  $V$  equal current  $i$  times resistance  $R$ . Electrical engineers use the symbol ‘j’ for the square root of negative one.

In reality, most mechanical engineers would recognize  $V=iR$  as the electrical equation because they are familiar with that example for basic physics context. Essentially, their implicit knowledge supplies the correct context for interpreting  $V=iR$ . In many other cases, the two disciplines would not share the same common knowledge and the ambiguity and confusion would remain.

What I learned in ME 6101 is that in order to distributed teams of designers to be successful in 2020, we will need to bridge this type of communication gap. The question is, “How can people from different thought worlds communicate and collaborate on decisions?” One way would be to create a standard language to represent decisions. For example, a DSP Template might capture the necessary information in a common language.

By completing my LE9 on Decision Based Design, relating it to the lecture material, and speaking with Farrokh, I learned that once something is captured unambiguously in something like a DSP template, there is no reason for the human to be involved. A computer should be able to take the DSP template and process it. The question is how to accurately capture all of the necessary knowledge and information from different disciplines and objectives. For the foreseeable future, the role of a decision maker will continue to be played by a human.

## 9.2 How you say it matters, too

It isn’t always sufficient to speak the same language; often, the use of the language and other signals affect how a message is received. Communication is more than just words, it is about forming relationships.

### 9.2.1 We named the dog Indiana

Indiana and his father have had a somewhat stormy relationship. Communication and understanding were never their strengths.

INDY: Do you remember the last time we had a quiet drink? I had a milk shake.

HENRY: Hmmm... What did we talk about?

INDY: We didn’t talk. We never talked.

HENRY: And do I detect a rebuke?

INDY: A regret. It was just the two of us, Dad. It was a lonely way to grow up. For you, too. If you had been an ordinary, average father like the other guys' dads, you'd have understood that.

HENRY: Actually, I was a wonderful father.

INDY: When?

[HENRY looks up from his Diary.]

HENRY: Did I ever tell you to eat up? Go to bed? Wash your ears? Do your homework? No. I respected your privacy and I taught you self-reliance.

INDY: What you taught me was that I was less important to you than people who had been dead for five hundred years in another country. And I learned it so well that we've hardly spoken for twenty years.

Just after Henry is introduced in the movie, he and Indiana have the following brief exchange, in which the audience learns that Henry calls Indiana by a name that he doesn't like.

HENRY: It is you Junior!

INDY: [an old familiar Irritation] Don't call me that, please.

At the end of the movie, Indiana is struggling to save the Grail from falling into an abyss. His father is grasping one of his hands as Indiana dangles into the crevice, stretching for the Grail. At this point in the movie, communication and mutual understanding is of vital importance, because Henry is losing his grip on Indy.

[Now the ledge INDY lies upon begins to break apart. HENRY grabs one of his hands as Indy struggles to reach the Grail with the other.]

HENRY: Junior, give me your other hand! I can't hold on!!

INDY: I can get it-I can almost reach it, Dad.

[INDY looks down into the black bottomless pit beneath him from which nothing can ever be retrieved.]

HENRY:

Indiana...Indiana!!

[INDY snaps his look up to his father. His father has never called him this before.]

HENRY: [very calmly]... let it go...

[INDY abandons the Grail and grabs onto HENRY with both hands.

HENRY pulls him up to safety.]

Henry's first attempt to convince Indiana to give up on the Grail failed, because it did not slice through Indiana's preoccupation with the Grail. However, when Henry pleads, "Indiana...Indiana," he grabs Indy's attention, because his father has never before called him by that nickname. Borrowing from the notion of the oracle in the *Matrix*, Henry told Indiana what he needed to hear in order to make him do the right thing. It was Henry's presentation of his plea that was effective.

For completeness of the movie, I feel compelled to add the following dialogue, in which Henry reverts to calling Indiana "Junior", which illustrates that he really did call him Indiana earlier just to get him to listen.

HENRY: What did you find, Junior?

INDY: Junior?! Dad...

SALLAH: Please...What does it always mean, this...this "Junior?"

HENRY: That's his name. Henry Jones, Junior.

INDY: I like Indiana.

HENRY: We named the dog Indiana.

BRODY: May we go home now, please?

SALLAH: [to INDY] The dog!?! [laughs] You are named after the dog...

INDY: [embarrassed] I've got a lot of fond memories of that dog.

### 9.2.2 Greenlight to improvement

By writing my LE4 I explored ideas about how to be a good leader. The lesson that I learned from thinking about Farrokh's use of a green pen to provide feedback is that the subtleties of presentation of feedback can make the difference between your message being heard and ignored. Much as Henry's use of "Indiana" showed Indy that his father really cared for him and understood his feelings, Farrokh's use of the green pen shows his students that he is there not to bring them down with criticism, but rather to give them a green light to success.

A larger lesson that I drew from my LE4 is that people, including myself, cannot expect to advance and improve in any way but through small steps. This lesson has two applications.

First, as a leader or teacher, one should provide feedback directed at helped the recipient of the feedback to take the next steps on his or her journey. As I wrote in LE4,

People cannot change overnight, so why ask them to? An individual can only change in small steps, so in criticizing their work, one should point out to them the first and most important steps that they should take. You can always tell them the next steps later. In this case, they don't need to know the whole journey, just the next step. If they are guided from one step to the next, they will eventually climb the mountain. If there were shown the size of the mountain from the beginning, they might have turned back.

When someone feels overwhelmed, it is hard to make progress. I felt this way as ME6101 began. There were so many items on the smorgasbord that I didn't know where to start. As I realized while writing my LE3, "I need to reduce the number of augmentations...that I seek to explore...", otherwise I would never even get start. Similarly, if you dump too many suggestions or criticisms on someone at once, that person will become defensive and unwilling to take any of your advice to heart.

This lesson is similar to one of the principle points that I abstracted from P&B in my A1B. Complex problems are best solved in small steps, whether that problem is learning, improving, designing, or searching for the Holy Grail.

The second part of this lesson deals with establishing personal goals. Farrokh is correct that having definite long term goals and dreams is one way to help you choose your own path in life. That does not mean that it is easy to define one's goals, only that it is important to have them. Without a long term goal—a future destination—in mind, one can be easily sidetracked by distractions or other people who have their own agenda for you. Therefore, having a clear goal in life is like having a clear product proposal and requirements list in design.

Having a long-term goal is crucial for success, but that long-term goal might seem insurmountable. Progress towards a long-term goal will usually be slow, and this can be

discouraging. It is also easy to stray from this long-term goal. For these two reasons, short-term goals are necessary.

Short-term goals serve two functions. First, they direct your attention towards your final destination—your long-term goal. Second, they can serve as mileposts measuring your progress. This is positive for morale and the motivation to keep going. Even if you never achieve your final goal, you can be proud of the progress you made, and since it is in the right direction, it should be valuable to you.

The importance of short-term goals as a part of a long-term vision was stressed to me on the first day of class when I was asked to list my A0 goals for the course. Farrokh's comment of my A0 was that my strategic goals do not align with the goals I've set for this course. Therefore, I was planning a path in the wrong direction. In ME 6101, I have learned that a series of goals that lead towards a long-term goal are valuable. My goals will help to direct my progress and motivate me. In addition, just the act of creating the goals forces me to come to some belief about what is important to me. This belief will help me choose from the smorgasbord of opportunities presented in ME 6101 and life. I will never be able to do everything, so I must choose what will create the most value for me in the context of my beliefs.

By forming goals, I am taking a systematic approach to living my life, instead of roaming like the nomadic cowboy. Therefore, this lesson ties directly back to systematic design and the P&B process.

## 10 Did I find the grail?

The Joneses went on a *Last Crusade*. In the end, they found the Holy Grail. My question to myself about ME 6101 is, "Did I find my holy grail?"

### 10.1 Learning to Keep Learning

I stated in the introduction the holy grail of ME 6101 is learning to keep learning. Two lessons that I have presented in this story are closely related to this goal. My learning to look at things from different perspectives will serve me well as I seek to frame and answer research questions in my Ph.D. program, and it will go beyond that. I will help me in life and in my career as I try to picture myself in someone else's shoes or seek a new application for an old tool.

I also learned the value of keeping a learning diary and using the ORA construct by writing learning essays. This skill will help me to read and think deeply, as well as to add value to previous lessons learned. A learning diary can help me move and keep things in a conscious part of my mind, and learning essays and the ORA construct will help me to build my competencies. It is hard to imagine a more valuable learning skill.

These two lessons learned are the holy grail of ME 6101 because they will persist after the page turns on the fall semester; the ability to keep learning, and learning to keep

learning, is an immortal part of ME 6101. As long as I keep returning to the grail (my lessons learned), my accomplishments in ME 6101 will live for ever—or at least as long as I do!

## 10.2 My A0 Goals

I began ME 6101 by formulating goals for the course. These goals changed during the first few weeks as I learned what I wanted to accomplish and what opportunities would be available to learn. I have not focused on the progress and value that I achieved towards my goals in this learning essay. I chose to focus more on the other lessons, the ones that aren't as obvious. I have critically evaluated my progress towards these goals in my A2Q4S. However, the A0 goals form a central pillar of the ME 6101 scaffolding, so I will address them here briefly by relating them to *The Last Crusade*.

### 10.2.1 Primary Goal

My primary goal was aimed at building the foundation for a DETC paper. Indiana Jones begins most of his adventures with the mindset that “It belongs in a museum.” When it comes to my adventure in ME6101 and Indiana’s in *The Last Crusade*, we both came up short; I will probably not have a paper for DETC 2004 and the Holy Grail is not in a museum, but rather lost forever.

In my case, my goal is not lost forever, because I still have formed the basis for future research, and my primary goal has directed my course work along a direction that will make it relevant to my goals outside of ME 6101.

For Indiana and me, the journey was more important than our original goals. Along Indiana’s journey, he gained a new relationship with his father, one that may or may not persist after the final credits roll. There is already a hint that they won’t, as after leaving the temple, Henry reverts to his old ways of calling his son:

HENRY: What did you find, Junior?

INDY: Junior?! Dad...

In my case, I have learned all of the lessons presented in this paper, and more. The question is whether these lessons will live on after the credits roll on ME 6101, which I address in the Section 11 of the paper.

### 10.2.2 Secondary Goal

My secondary goal was to “Augment the P&B process to incorporate modern tools such as computer simulations, knowledge representations, CAD, and other computer- aided engineering tools and mathematical models, as well as identify opportunities to create new tools.”

The biggest lesson that I learned here was the role that tools should play in the design process. I discovered the role that these tools (simulations, knowledge management systems, and risk assessments) play in the design process; specifically, their role is to extend the human designer’s abilities. I have come to understand the motivation and role for Farrokh’s notion of a human-computer cyborg. Now that I have a sense of the role tools play in design, I can continue to answer how the tools need to be changed or

augmented to better fill their roles, but I really did not succeed in augmenting P&B to incorporate these things in this course.

### 10.2.3 Deep reading goal

In the long run, I may have gotten the most value out of my efforts to meet this goal. As I illustrated in Section 4, this is one of the ways that I have learned to keep learning. In the future, I will be able to deep read and think deeply better than before. This will allow me to keep learning on my own, without a course orchestrators providing scaffolding.

### 10.2.4 Group systematic Design goal

As I have explained in Section 3, I learned a lot about the value in following a systematic approach to design. Some of these lessons came from following a systematic approach to designing a design project. The systematic approach helped my group measure our progress, delegate tasks, and stay on the same page. It also helped lead to the creation of a project that, if completed, would move both of us a long way towards achieving our goals.

### 10.2.5 2020 Vision goal

The ability to look to the future will help me to be a better strategic thinker, which will help me to position myself for the future. Hopefully I can be like Wayne Gretsky and “skate to where the puck is going to be.” I employed several methods for developing this vision, including exploration by analogy, leveraging the opinions of others, and drawing from my own experience. Indiana Jones does not seem to have strategic vision. He rarely anticipates what might happen, he just goes, which makes for a very exciting and suspenseful movie. However, it is a lousy approach to design and a stressful way to live life. In real life, I don’t believe we benefit from predestination of script writers. As I wrote in my LE3, the future is a place to be created, and by helping to create it, I can make it something that I like. If I let others dictate the future, I have to live by their rules.

### 10.2.6 Qualifier goals

Just as the Grail Diary gave Indiana the clues to pass the tests, ME 6101 has provided me with the clues to pass my “final challenge”. However, ME 6101 has given me more. Indiana did not what the clues meant when he needed to use them, which almost cost him his life twice. ME 6101 has given me practice in applying P&B, thinking deeply, and internalizing an approach to design. This should make me more prepared to face my challenge than Indiana was for his.

## 11 Where is the next adventure?

I don’t know if there will actually be a fourth *Indiana Jones* movie or not (there are rumors about one), but I do know that there will be a next installment of my life. Much as the continuity must be checked in a script for movie sequels, I should check for continuity in my life.

In this essay, I have recognized that I have learned the value of a systematic approach and a learning diary. I have speculated that these lessons will be very valuable. However,

they will only be valuable if I remember them and use them in the future. If someone else stands up at the end of 2004 and looks at my work in ME 6101 (Part 1) and compares it to my life in 2004 (Part 2), they should not be able object to Part 2 and say the equivalent of, “That doesn’t make sense based on the previous film!”

As I proceed from here, I need to be my own consistency checker. There are not millions of fans analyzing whether what I do next makes sense given what I’ve already done; there is only me. As I write my life’s story, I need to be own best critic and my own continuity editor.

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## Note on Movie Quotes

The quotations from the movie for taken from a copy of the script available at <http://www.twiztv.com/movies/indianajones3.htm>. I do not know whether this script was reproduced with permission.

*Indiana Jones and the Last Crusade* was released by Paramount Pictures in 1989. The names *Indiana Jones* and the title *Indiana Jones and the Last Crusade* as protected under various trademarks of Lucasfilm, Ltd.