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# Memory Errors in Project Management

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A lot of the mental mistakes we are prone to in project management are related memory. Often, we cannot properly assess events because we have forgotten similar events that occurred in our past. In this paper we will explore how certain features of our memory can affect project management and how we can improve our memory and hopefully improve our project management.

## *Memory Errors in Project Management*

The West Gate Bridge is a steel box girder cable-stayed bridge in Melbourne, Australia. The total length of the bridge is 2,582.6 metres (8,473.1 ft). The West Gate Bridge carries five lanes of motor vehicle traffic in each direction.

On 15 October 1970 during construction, the 112 m (367.5 foot) 2,000-tonne span plummeted into the Yarra River. Thirty-five construction workers were killed; most of whom were having lunch beneath the bridge. The ensuing investigation concluded that bridge collapsed because of errors in structural design and construction. On the day of the collapse, construction workers were trying to connect two half-girders, which were not fully vertically aligned. Engineers proposed to load higher half-girders with 10 concrete blocks weighing 8 tons each. This extra weight caused the span to buckle and ultimately led to the collapse (Hitchings, 1979). Eventually the damage was repaired and the bridge currently serves as a vital link between the city center and its suburbs (Figure 1).



Figure 1. West Gate Bridge. Melbourne, Australia.

Why did the engineers decide to add the additional weight to the bridge during construction? Because they took for granted that that the structure would handle the additional weight and no analysis of the proposed solution was necessary. The root cause of such failures of judgment are usually attributed to ignorance, insufficient knowledge, lack of experience, or miscommunication between the different engineering and construction teams. But it is very important to remember that behind each such failure there are a number fundamental psychological problems, biases, and mental errors. We believe that one of the fundamental reasons behind this construction mistake as well as many others was memory errors. Engineers and project managers often don't remember to analyze certain risks or forget to perform necessary analysis. In our example, it is hard to believe that people did not to consider that the extra weight could destroy the structure: every child that has every played with Lego understands this concept. But professionals must "remember" that under certain conditions such as adding weight they must perform the analysis. It is a very basic part of engineering education.

An important thing about memory errors is that they are often accompanied by other mental mistakes. We cannot say that the bridge only failed because the bridge's engineers forgot to perform an analysis. Most likely it was a combination of memory mistakes, optimism bias, overconfidence, and other mental mistakes. But memory error was one of original issues leading to other biases; therefore it is so important to understand and mitigate memory errors.

Let's say you forgot where you put your glasses. Best case you may eventually find them, or worst case you have to buy another pair, no big tragedy. If a project manager forgets about a certain risk and manages the project without taking it into account, there can be dramatic consequences. In project management most memory mistakes are related to risk identification, because certain risks or their potential impacts are easy to forget. Mistakes of this type occur when organizations do not have a process for risk management and analysis.

### *What is a memory?*

Sometimes people think about memory as a tank of water. We fill the tank with information, once it is filled, to add new information, we need to empty it a bit and then add new information. The tank may have a leak - we may forget something. In reality, this model is incorrect: our memory is not a simple storage tank. It is much, much more complex. Here are the three most important concepts about memory.

1. Memories are generated when information is recorded. The quality and substance of the memory depends on several factors, including the situation, environment, and other experiences that occurred during the time when the memory was formed. Daniel Gilbert (Gilbert 2006) demonstrated it using the following example. Take a look at the cards shown on Figure 2. Pick one card and remember it. In a few pages we will come back to this example.



Figure 2. Pick one card

2. Different pieces of information are not stored as discrete units in our brains. We do not simply memorize different pieces of information; we construct and memorize general scenarios (Roediger and McDermott 1995). Let's demonstrate it. Here is a list of words:

3. **Quality Control, Project Execution, Risk Management, Project Time Control, Procurement Management, Project Scope, Meeting with Stakeholders, Project Sponsor, Gantt Chart, Project Cost Analysis, Agile Method, Human Resources Management, Critical Chain.**

Now, without looking at the list, guess which phrases were not in there: **Project Sponsor, Project Management, Drunk Driving, and Project Cost Analysis?** One correct answer is Drunk Driving. However, there is another

correct answer: project management. Because all words in the list were closely related to project management, your brain processed and saved them together. Under normal circumstances, it is very efficient way to memorize things. But in this case your brain was misled.

4. Memories are reconstructed when we recall information. This information may include memories of the original experience blended with other information. Try it yourself (Myers 2007). Close your eyes and try to recall a pleasurable situation you experienced in the past. So what do you see? Most likely you will see an image of yourself. But if you can see yourself, it is not an original scene, it is reconstructed scene based on your original experience.

All of these effects make our memory quite unreliable. The result is that when we try to compare different memories or with actual events, we may be subject to mental errors that can lead to wrong decisions. For example, when you try to identify project risks, you may remember risk associated with one particular project or type of project because this information is stored together. You may not remember risks from other projects even if these risks can be potentially applicable to your current project.

### ***Reconstructive Memory***

The way how memories are recorded and recalled are very dependent on context. Psychologists conducted the following experiment (Loftus and Palmer 1974). They showed students different movie clips that depicted traffic accidents. Then they asked one-fifth of the students “About how fast were the cars going when they contacted each other?” An equal number of students were asked the same question except “contacted” was changed to “hit”, “bumped”, “collided”, or “smashed”. The result was that the average speed estimate by students who were asked the question with word “smashed” was 9 miles per hour faster than by students who asked question with word “contacted” (40.8 miles/hour vs. 31.8 miles/hour).

The week after watching these movies, the psychologists asked students if they remembered broken glass when the cars “smashed” or “hit” each other. If students were asked the question with the word “smashed”, they were the most likely to recall some broken glass, although in the movies there was none. This example shows how we reconstruct previous experiences based on memory and other information.

The human memory works in such a way that while recollections may appear quite realistic and tangible, various details may have been gleaned from other sources of information, especially if there is a significant period of time between the event and the attempts to recall it. This makes interpretation of past events very difficult. Police investigators, lawyers, and judges know about this effect, because sometimes it is difficult to understand what was real and what was a product of the witness' imagination.

This effect has important implications in project management. Project manager's experiences will be reconstructed most likely in the context of the recent project he or she is working on.

## *How memories are created*

Now let's go back to our card example. Amazingly, you will see that we have removed your card: the card with you selected is not there. At this point, you might ask how we did it, or think think are these guys amazing or what? As it turns out, we are not all that amazing, just tricky. Take a careful look at Figure 2. and Figure 3. In fact, all cards shown in Figure 3 are different than cards on Figure 2. However, when you selected your card, your brain only memorized the verbal label of the card, such as Jack of Hearts. You did not try to remember other cards. The result is an illusion.

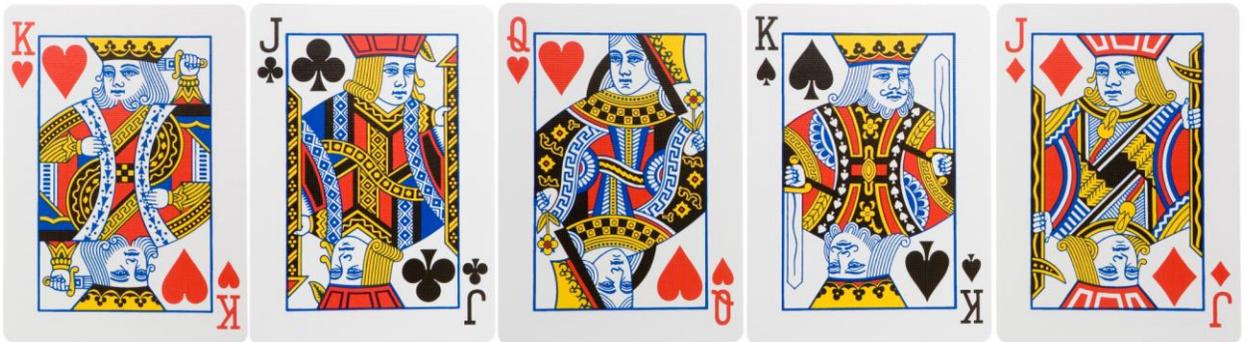


Figure 3. Your card is not here

When people don't try to specifically memorize things, they end up with quite distorted memories of the events. Two psychologists secretly recorded discussions which took place after meetings of Cambridge Psychological Society (Hunter 1964). Two weeks later they asked participants to recall the discussions. The participants forgot more than 90% of specific points of the discussions and remaining 10% were substantially incorrect. Moreover, they recalled comments and details that did not happen. How would you do? Can you accurately recall the discussions you had during your team meeting last week? This example emphasizes how important is to keep accurate records.

Although keeping accurate records is recommended by various project management procedures, it is often ignored. Even if your project team managed to create records of its meetings and other documents, would you know where these records are and have easy access to them? Though there are many good collaboration tools available that perform this function, often our memory is the only practical tool we can use. So let us learn how we can improve our ability to memorize things.

### *How to improve your ability to memorize*

Information related to project management is often hard to memorize. If you have studied for their PMP exam, you probably agree that the PMBOK® Guide (Project Management Institute 2013) contains many general statements and descriptions of processes that are hard to remember.

How can we improve our ability to memorize information? First of all, everything depends on how you want to use this information. If you need the information only for short period of time, you engage your short term memory. For example you need to enter three numbers from a spreadsheet to a project schedule:

**6.435, 4.346, 5.012**

Try to memorize these numbers and then without looking at them write them on a separate piece of paper. The easiest way to do this is to remember a verbal label associated with this numbers. Read these numbers a couple of time: six point four three five, four point three four six, and five point zero one two. You will remember these numbers only for a minute, but it will be enough to record them piece of paper.

However, in most cases you will need to remember information for a longer period of time. In this case, you need to associate the information with something else that you are familiar with or form associations between the different pieces of information themselves. It will help to visualize images for the various pieces of information which may or may not have explicit relationships with this information. When you do it use the following tips (MindTools 2010, Buzan and Buzan 2010):

- Use positive, pleasant images. Your brain often blocks out unpleasant ones.
- The images may contain not only static pictures, but also movements, sounds, even smells or tastes. Engage as many senses as possible to create the most vivid impression.
- Use color or make images three dimensional; for example if you try to memorize a block diagram or graph use different colors for different components.
- Connect different pieces of information using a mental movie; it will help you to remember actions
- Use symbols (traffic lights, road signs, etc.)

Here are a few memorization methods based on these ideas:

1. **Link method.** This method can be used to memorize lists. Perhaps you need to remember phases of projects as it is described in PMBOK® Guide: project initiation, execution, monitoring and control, and closing out. One suggestion is to create a mental image of a person walking inside a building: opening door (initiation), walking (execution), looking at other people (monitoring and control), and leaving the building and closing the door (closing out).
2. **Story method.** Similar to the link method. Create a story about something you are trying to remember. Try to visualize a character or set for this story – this will make the story more vivid.
3. **Numbering.** If you need to remember an ordered list , try to number elements of the list, even if the original list not always numbered. For example, if you want to

remember the American Presidents you may try to assign numbers to each of them. Grover Cleveland was 24<sup>th</sup> President and William McKinley was 25<sup>th</sup>.

4. **Location method.** If information can be somehow associated with different locations, try to mentally visualize a map.
5. **Faces method.** Try to assign an image of a person to create a relationship with the information you are trying to memorize. The person may have any relationship with the concept, even very weak one.
6. **Timeframe method.** If information is time related, put it visually on a timescale. Timescales do not always have to be linear. Years can be visualized as a circle as shown on Figure 4. In this way, it is easier to remember durations. You can also compare events in the current and previous year, a common practice in project management. Did you know that because the spatial positions of the hands, people often prefer conventional watches to digital watches because it makes it easier for them to assess duration?

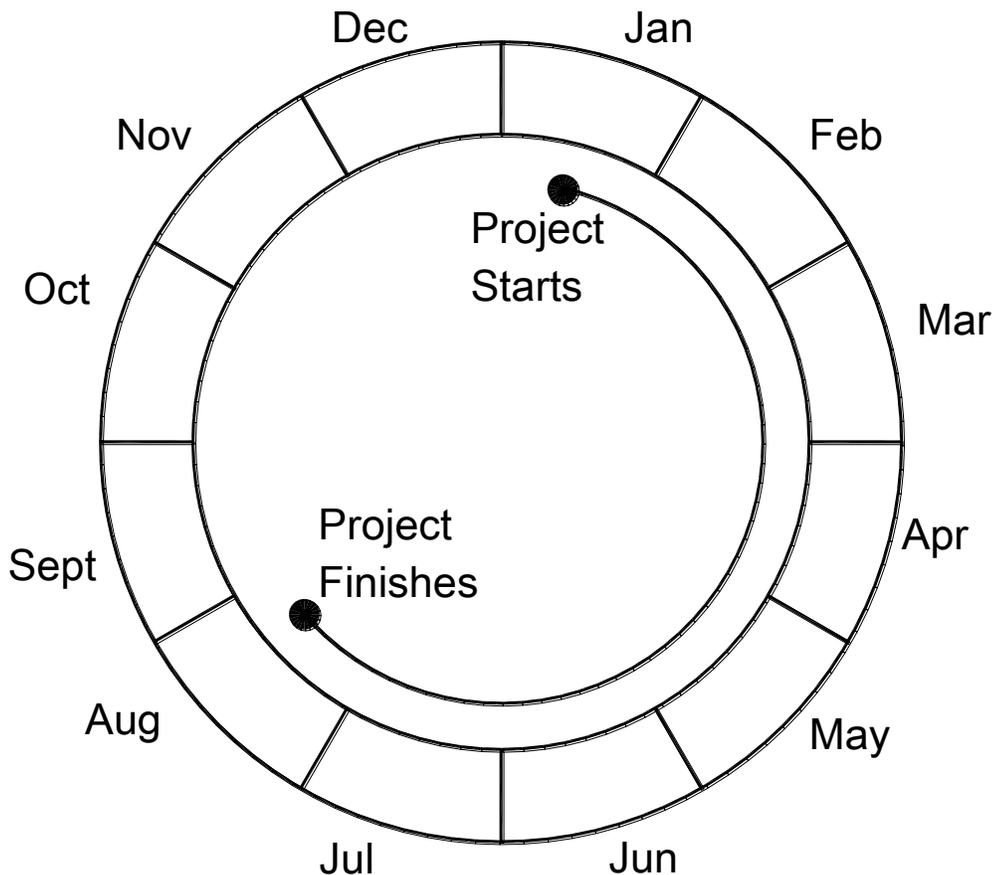


Figure 4. Timeframe Method

7. **Hierarchies and mind maps.** Try to organize information in hierarchies or mind maps where you can create relationships between different pieces of information (Wycoff 1991, Nast 2006).
8. **Loci method** (Higbee 2001, Yates 2001). Very often you need to memorize different words which cannot be easily associated with mental images. Imagine something familiar, such as your street or your house. Take a moment to conduct a mental walk through of the rooms in your house. Ensure that you can move easily from one room to another. Along your route create a list of "loci": well defined parts of the room such as a door, a bed, etc. When you need to memorize a list of words or ideas, you can form visual images for each of the words and place them, in order, on the loci in your route. To recall the words or ideas, you take a mental walk through your house, asking yourself , "What is on the living-room door? What's in the bedroom. And so on.

A good memory is a powerful tool for project managers; they often need to memorize different numbers, such as costs, productivity, and to recall them accurately and concisely if called upon. In most cases, this information is associated with something that can be visualized. For example, when you think about the duration of software development tasks, you may mentally associated tasks with team members.

### ***Do Memory Exercises Actually Work?***

If we spend time solving complex logical problems, such as playing Sudoku or Chess, does it help to improve memory and reverse negative effect of aging on mental abilities? The answer is apparently yes but only to a certain extent (Aamond and Wang 2007). Apparently, mice and monkeys of all ages that are given playmates or toys, will learn to complete a variety of tasks more easily than those that do not. However these experiments were conducted with captive animals and it would be difficult to extrapolate these results all animals and humans.

Other experiments show that elderly people who regularly perform mental exercises often improve their cognitive abilities. However, these improvements are often limited to the specific tasks they performed during their training. For example, playing sudoku may not improve your overall mental abilities, but the will make you a better sudoku player.

On the other hand, physical exercise has been proven to be an effective way to maintain and improve brain health. Exercise improves what scientists call "executive function," the set of abilities that allows you to select behavior that's appropriate to a situation. One of the examples of the "executive function" is the ability to focus on the the job at hand in spite of distractions. Executive function usually degrades in our 70<sup>s</sup>, but physical exercise, such as fast walking helps to maintain it. Physical exercise also helps to reduce risk of dementia. Scientists have discovered particular neurological mechanisms which explain the effect of physical exercise on cognitive functions. So if you are a project manager, buy fitness membership for your team and yourself. It may work better then many other attempts to improve mental abilities of your team.

## Using Choice Engineering to Mitigate Memory Errors

Strange things happened with our memories. They seem to be distorted at any step: when memories are created, inside our brain, and when we recall this experience (Figure 5). In project management we definitely don't want to base our judgment on significantly distorted memories.

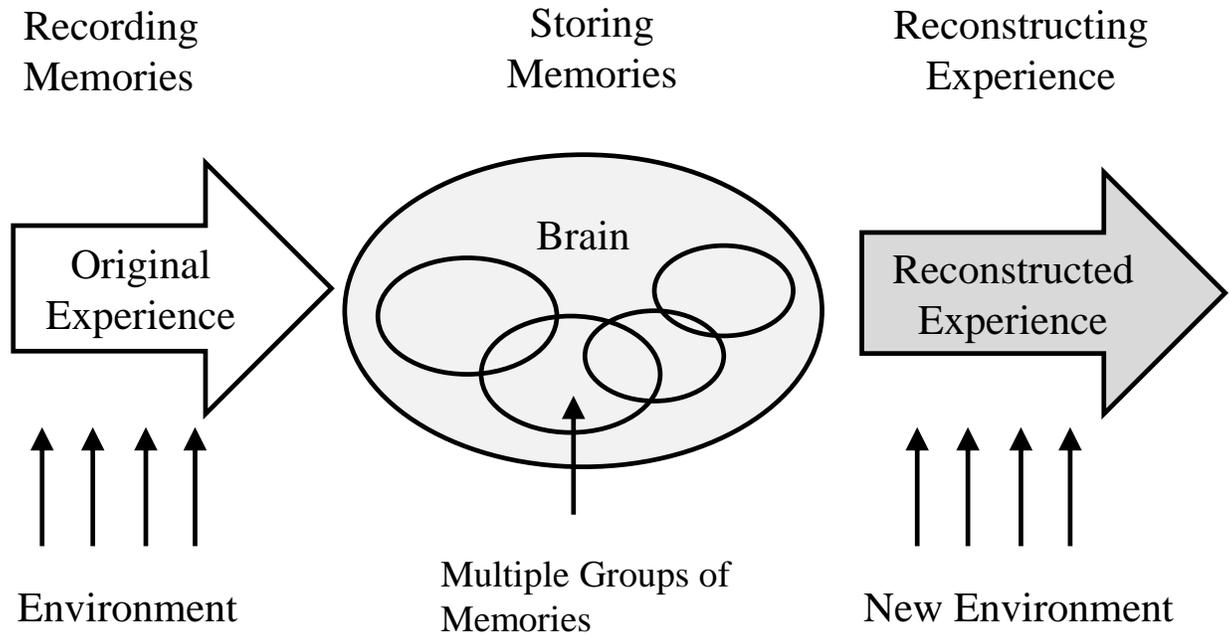


Figure 5. Experience and Memory

We cannot mandate project managers to improve their memory. While we cannot completely eliminate memory errors, we can at least create an environment in which their negative impact will be mitigated. Here are few suggestions:

1. **Rotation.** The first suggestion is very trivial although many organizations don't follow it. Since our brain would distort our memories anyway we need to create many experiences from different sources in such a way that they will be stored in different groups in our brain. Applying this to project management would mean that the organization should encourage people to get experience from as many different projects as possible. Not only should the project types be different, but team members should try different roles, such as engineer or a project manager. Many organizations don't encourage the rotation of project managers or engineers so they are never exposed to different projects. Very often project managers are invited from outside of an organization or from different divisions without any experience in particular project. Sometimes it can work. But it can cause problems, especially if a project already underway.
2. **Industry events.** Many projects can run for years. It is hard to get different experiences if you work on one project for a long period of time. It limits memories and many memories will be combined in a limited number of groups. The solution is to go to different events, such as conferences or symposiums, or attend some training. Most companies recognize the importance of such events, but put on many conditions

for employees to attend them. Some companies have a cap on number on conferences or expenditure for training or consider these events as some sort of perk. If a company's earnings are down, they may impose various travel bans. Sometimes it happens so often that most people don't actually know when bans are lifted. Most conferences are held in nice places and include some entertainment. It is another reason why some executives think that industry events are perks. But we remember things better if they are created in a distinct and positive environment. Industry events are not perks; they are necessary to ensure high quality projects and good company performance.

3. **Corporate knowledge base.** A number of computer tools are available to help establish a company's knowledge base. Not all companies have corporate portfolio management software, and not all companies would store project documents related to decision analysis, even if they did have the software. But there is a simple and effective way to establish a corporate knowledge base: Save all your documents on a corporate intranet in such a way that they can be searched using search tools similar to Google or Bing (Virine and Trumper, 2007). Just make sure you use proper keywords for your documents so that the search tool can return the most relevant documents.

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