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Amazing Checklists

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Separated in time by almost three and a half millennia, they share a fundamental simplicity of design--a simplicity so lucid it enables the fault-prone grasp of fleeting, human memory to repeatedly apprehend and regulate complex processes in a systematic and repeatable way. Their characteristic serial structure guides our responses to a succession of tasks or to a flow of information in the way in which we naturally experience them--that is, as one thing occurring after another in a continuous, linear sequence.

And while we may sometimes disparage them as a bureaucratic nuisance--shopping lists on steroids that chain us to the rote performance of repetitively mundane tasks--checklists are a remarkably persistent and versatile solution to the problem of navigating a variety of complex tasks and activities. Historically, the emergence of checklists as a prominent and integral part of managing the quality and efficiency of industrial processes has been driven by successive waves of technological advancement, from the smokestack to the digital era.

Perhaps the most well-known proponent of checklists is the eponymous inspiration for this website: Henry Laurence Gantt, whose *Organizing for Work* (published nearly 100 years ago) introduced a system of charts for tracking (among other things) the orders for component parts from a specific contractor, as measured against the starting month and the ending month for each order in the delivery schedule. What is less well known, however, is that Gantt's solution to managing an Industrial Age problem was not unique to his own time but had a much earlier incarnation--in an ancient agrarian society far removed from our own.

Keep on taking the tablets (1350 BC)

Uncovered at the turn of the 20th century by the archeologist Sir Arthur Evans on the island of Crete, no one could decipher the strange linear script inscribed on the nearly 4,000 clay tablets found scattered around the many ruined rooms at the excavation site. Due to its location and supposed age, Sir Arthur believed that what he had discovered was the palace of the legendary King Minos at Knossos where--at its center, imprisoned in an impenetrable maze--lived the Minotaur, a mythical creature half bull, half man.

Because the odd-looking script was unknown, Sir Arthur assumed it was written in the lost language of the Minoans, a language very different from and much older than ancient Greek. But why were there so many tablets? And what was written on them? Did they perhaps contain the secrets of the Minotaur's labyrinth? Or an epic poem older than Homer's *Iliad*?

The decipherment of Linear B (so named because of the script's distinctive angular orthography) by a gifted amateur linguist, nearly 50 years' after Sir Arthur's discovery, has become a well-known tale of linguistic detective work. However, what has been overlooked in this story is how Linear B helped an ancient civilization manage a complex organizational problem.

Building on the work of other linguists and in partnership with John Chadwick, an expert in Greek dialects, an architect named Michael Ventris finally decoded the indecipherable script in 1952 and demonstrated that it was not a new language but was, in fact, a written form of Mycenean Greek that dated back to around 1350 B.C. And what Ventris and Chadwick uncovered when they started to decipher what was written on those tablets was both more mundane and more surprising than anyone had expected to find.

Many words in Linear B's vocabulary referred to a wide variety of Mycenean commodities and mercantile objects (e.g. oil, flour, wool, cloth, boxes, axes, wheels, swords, arrows, etc.), together with adjectival qualifiers (e.g. not assembled, made of wood, with two handles, made of cypress, etc.) and quantities, mainly represented by simple ideograms signifying numerals (measures of weight and volumes, both liquid and dry).

Collectively, what the tablets revealed was the administrative functioning of a vast palace, a network of almost 1,500 rooms so complex it had obviously given rise to the myth of the Minotaur's inscrutable maze. Because it was only found in very limited administrative contexts it was clear that Linear B's shorthand syntax (noun + qualifier + quantity) had been purposefully adapted by the Myceneans to support a systematic accounting and classification of mercantile objects, a system in which each tablet was a transactional checklist that regulated the flow of commerce into and out of the palace.

The tables of account were integral to the maintenance of a comprehensive and methodical commercial inventory. Importantly, as administrative tools, the tablets enabled King Minos to know exactly what had been received at Knossos and what had been disbursed. Closer analysis of the tablets' orthography also revealed that they had been inscribed by fewer than 100 individual hands. What this indicated was that the oversight and recording of these transactions was performed by a very select and highly specialized group of scribes.

Without those clay checklists on which the well-regulated record-keeping system depended, the intricate commercial labyrinth of Knossos might have quickly collapsed into chaos. Moreover, the tablets were probably not deliberately designed with the intent of managing the complexity of Mycenean commerce but rather--because they proved to be such an effective tool for regulating the palace's administrative

processes—they enabled Knossos to grow in complexity.

Checklists can create remarkable step-changes in our ability to manage complexity, in particular by making such changes repeatable. And like the tablets at Knossos, a 21st century application of checklists to complexity demonstrates the extraordinary results that can be achieved by focusing attention on the performance of such mundane tasks as the simple act of washing one's hands.

Keep on taking the tablets (2001 AD)

The daunting challenge of bringing Intensive Care Unit (ICU) patients back to health is today met with an arsenal of extremely complex and sophisticated medical technology that is used to achieve--what to the ancient Myceneans, and even to us, appear--miraculous: the seemingly dead restored to life.

Guided by the specialist skills of intensivists (doctors trained in intensive care medicine), applying the right medical procedures in the right sequence at the right time so that ICU patients can be brought back from the brink of death and rehabilitated depends--above all else--on successfully managing complexity. (This is the dramatic premise that underpins the plot of every episode of the American TV series *House M.D.*; each week, the super-specialist team of doctors must navigate the baffling complexity of the patient's medical condition and find a cure.)

The argument for placing ICU patients under the supervision of intensivists is self-evident when you look at the order of complexity involved in caring for an ICU patient. A study of the treatment of 41,000 trauma patients in the United States identified 1,224 different injury-related diagnoses in 32,261 unique combinations. But despite the skill and experience of the intensivist in diagnosing and prescribing the right course of action, the survivability of those trauma patients also depends on the correct performance of some fairly routine medical procedures, such as inserting a catheter into a patient.

Due to the traumatic nature of their condition, ICU patients are nearly always wired into one or more life-support systems that provide nourishment, perform and regulate body functions or deliver medicine to where it is needed. The paradox is that wiring patients up to those life-saving systems can sometimes be as life-threatening as the trauma injuries for which the patient is being treated.

In the States, for example, infections arising from catheter-related bloodstream infections were occurring at a rate of about 80,000 patients per year in 2007. Fatalities from line infections varied between 5 and 28 percent of cases depending on the condition of the trauma patient. For example, 6 percent of patients who spent 10 days or more on a ventilator machine developed bacterial pneumonia. And in 40 to 55 percent of those cases, the patient died from the infection.

In 2001 at John Hopkins Hospital in Baltimore, an intensivist named Peter Pronovost decided to do something about this. His solution was not to reconfigure or improve the life-support technology available or create a more effective anti-bacterial medicine. His solution was much more radical. Pronovost wrote down the steps involved in putting a line into a patient without causing infection. He created a checklist.

Pronovost then persuaded the hospital to use the checklist. The results were startling: Over the course of a year, the 10-day catheter-infection rate fell from 11 to 0 percent. John Hopkins continued to use the checklist for a further 15 months, during which time only two line infections occurred. So successful was Pronovost's checklist that others were developed covering other procedures.

But the biggest test of the checklists' effectiveness was the Keystone Initiative, the goal of which was to reduce the catheter-related infection rate of ICU patients in Michigan hospitals. (The results of the project were published in The New England Journal of Medicine.) Keystone saved an estimated 1,500 lives and approximately $175 million in costs in the first 18 months of operation. And all this was achieved by simply writing down on a piece of paper the steps involved in inserting a line into a patient's body so as not to cause infection and then checking off the steps, one by one.

Repeat until symptoms disappear

That checklists can generate such impressive qualitative improvements in the performance of repetitive tasks is not an original insight. Project managers have known this for years. It is more surprising that checklists are only now beginning to play a prominent part in medical care at the start of the 21st century when project managers have been using them for so many years to perform quality control and as part of risk identification on their projects. So what is it that makes Pronovost's checklists any different from our own project checklists?

When you look at the results achieved, his checklists were exemplary in satisfying two cardinal objectives: as aids to memory recall in the performance of low-level, mundane tasks; and in making explicit the minimum steps required to successfully complete a task within a very complex system. But what makes then especially noteworthy is the reason why they were so successful: They changed the quality of the behavior of the participants involved in carrying out the tasks.

The key function of most checklists is to regulate interaction at the interface between a human agent and a machine or workflow process in the execution of a specific task. Whether it is an aircraft pilot preparing for take-off or a systems engineer powering down a Web server farm, checklists prescribe and control the correct sequence of events in which tasks are to be performed so that the process executed conforms to an approved and safe standard.

Checklists thus create consistency and predictability in the performance of a task by driving out variability and improvisation introduced by random behavior. This imposes a baseline quality standard on the process controlled by the checklist. In the case of Pronovost's line-infection prevention checklist, the quality standard rose not just from getting the prescribed steps right but also from the authority of the agent responsible for assuring that the correct protocol was followed.

Much of the success of the checklists derived from a change in the interaction between nurse and doctor. Nurses were given authority by

the hospital to direct doctors to adhere to the hygienic precepts of the checklist; this went beyond the usual informal prompting that nurses ordinarily give to doctors. (In the first month, nurses simply observed whether doctors were following the checklist. In more than 33 percent of cases, the doctor missed at least one of the five steps.) Despite the fact that doctors had to constantly evaluate and react to the changing condition of their ICU patients, enforcement of the checklist ensured that the distraction of dealing with an extreme medical situation did not cause an overlooked mundane task to inadvertently imperil the life of the patient.

Creating an effective checklist requires more than just subject matter expertise. It also requires an understanding of agent behavior, of how participants interact with one another in the performance of a task. It thus requires active and explicit governance--that is, an authorized agent accountable for compliance must also be involved in the performance of the task.

And whether it is a Mycenean scribe at Knossos or an ICU nurse in Michigan, someone must always be administratively empowered to enforce the checklist. (Supervisory governance--responsible for imposing penalties for non-compliance after the fact--while necessary in addressing systemic problems, is much weaker in preventing errors at the time when a task is performed.)

If 3,000 years of checklists illustrates nothing else, it is that the real value of a checklist derives not from the controls it imposes on how people perform tasks (they all perform them in the same way) but how people interact with others involved in the performance of a task. A task can always be improved by optimizing the steps involved in executing the task. However, by focusing more on the transactional aspects of a task, looking more closely at how agents work together, even greater improvements in quality can be achieved. Technology may change but human behavior remains constant. If you want to build a better checklist, attend less to the process and more to the people.

Ian Whittingham, PMP is a Program Manager in the Investment and Advisory business division of a leading global news and information company. Peter Pronovost's pioneering work on the use of checklists in the treatment of ICU patients was featured in a 2007 *New Yorker* magazine article by Dr. Atul Gawande. Last year, Dr. Gawande further elaborated on the value of checklists in his book, *The Checklist Manifesto: How to Get Things Right*. The views expressed here by the author are his own. You may contact the author directly at ian.whittingham@thomsonreuters.com.

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