Lessons of the Manhattan Project

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The Manhattan Project was, among other things, a gigantic industrial and engineering construction effort, run by the military under great secrecy, rapidly accomplished, using unorthodox means, and dealing in uncertain technologies. It central purpose was to develop and build an atomic bomb as quickly as possible that could be used to end the war. It got underway in June 1942, but only with the appointment of Army Corps of Engineers officer Colonel (quickly promoted to Brigadier General) Leslie R. Groves on September 17, 1942 did it become an all-out crash program. In less than three years (a little over a 1,000 days) the first bomb was tested on July 16, 1945 in the New Mexico desert. Three weeks later on August 6 the Japanese city of Hiroshima was bombed followed by the bombing of Nagasaki on August 9. The War was over five days later on August 14.

Distinguishing Features of the Manhattan Project

The Manhattan Project is often cited as the paradigm example, the model to follow to solve pressing technical or social problems. It is often said we need a Manhattan Project to do this or that, to cure cancer, or to solve climate change or the energy crisis. What was it about the Manhattan Project that makes us keep referring to it? What are its secrets and can there be modern efforts that use those methods to achieve success today?

One of the distinguishing features of the Manhattan Project was the simultaneous pursuit of finding ways to make fissile material for a bomb. The project leaders supported and funded three methods to enrich uranium and one method to produce plutonium, with the hope and expectation that at least one of them would work. In the end everything worked and contributed to the two types of bombs that were developed and used. The three uranium enrichment methods, all carried out at Oak Ridge in giant facilities, were the electromagnetic, gaseous diffusion and thermal diffusion. The plutonium was produced in reactors at Hanford, Washington and was reprocessed there.

The theory was sound for each of these methods. But transforming theory into practical engineering structures of great complexity that could rapidly produce significant quantities of HEU and plutonium was quite another matter. Nevertheless, assuming funding is not too great a hindrance, pursuing multiple lines of research and development seems a wise strategy for any large-scale effort.

Another characteristic of the Manhattan Project was the unconventional practice of conducting the research, development, and production phases simultaneously rather than following a step-by-step sequential path, that is the normal and slower way. Because every minute counted in wartime all of the steps were compressed, done in parallel, rather than one after the other. Occasionally there was a problem but the wrong choice was soon righted. In one example, machines to make the gaseous diffusion barrier material, based on one design, were being installed in a newly built factory. With work just about completed General Groves decided that an alternative design would be better. And so the just installed machinery was stripped out of the plant and new machines were put in their place.

This practice of compressing the different stages does not always work and should be a cautionary tale to any future projects. In the decades of the Cold War Capitol Hill committees overseeing Pentagon weapon systems termed the process "concurrency" and attributed to it the waste of billions of dollars with often defective planes, missiles, and tanks as the consequence.

Though Americans like to believe in the triumphant individual who meets challenges and overcomes adversity, it is really a blend of individual and collective effort that gets things accomplished. The leader finds greatness in the group and also helps them find it in themselves. All of this sounds familiar in Groves' running of the Manhattan Project.

Total program authority was vested in Groves. He had the complete support of the president and the other high officials of the administration. The full resources of the U.S. Treasury were available to him. In the end the Project cost about $2 billion (in 1945 dollars), which would be about $30 billion in today's dollars. The project was initially understood to involve possible national survival against an evil enemy bent on world domination that may have been trying to build an atomic bomb of its own. The objective was clear, unmistakable, finite, and well defined. Compartmentalization, in addition to maintaining security, kept people focused on their assignments and responsibilities to achieve it. Each element had its own task, and all were carefully allocated, assigned, and supervised so that the sum of the parts resulted in the accomplishment of the mission. Command channels were clear-cut, well understood, and direct. Authority was invariably delegated with responsibility. Large staffs were avoided, especially in Groves' Washington office. People at the higher levels knew one another from past experiences and could quickly communicate to solve problems and make decisions. Written communication was kept to a minimum. Most business was done verbally by phone or face to face. Groves' decisions were not based on staff studies, committee reports, written opinions of consultants, or the like.

The Manhattan Project was administered very much according to organizational model and practices of the Army Corps of Engineers, not surprising since Groves, the purest of specimens, was its head. The model emphasized decentralization but through clear lines of command to the top. If there is a secret to the success of the Manhattan Project I think it lies within the culture and organization of the Army Corps of Engineers and the high quality of the officers that ran it. They were used to big projects. Size did not faze them. Groves in his earlier capacity, just prior to being selected Manhattan chief, oversaw more than eight billion dollars' worth of domestic army construction projects during the mobilization period from 1940 to 1942 – four times that of the Manhattan Project. Just one of those hundreds of projects was the building of the Pentagon.

Groves always projected an optimistic attitude, which inspired others. Morale could only be sustained if everyone thought that the thing could be done. If Groves showed any doubt, hesitation, or fear, it might infect the others and undermine the project. Groves normally set completion dates that he was sure could not be met. Keep the bar high and people will work harder to jump over it. "As was always my custom I set completion dates which I was sure could not be met. It was only in this way that I could be certain that every effort would be made and no one could think of easing up if he had too easy a schedule." Success is not a matter of luck he said, "but the result of mental and physical capacity, of endeavor, of determination, and in large measure, of competent management."

After the war on several occasions Groves set forth the tenets he thought were fundamental to the speed, efficiency, and success of momentous undertakings by the government. In 1958, as the United States was in the midst of a crash program to develop and deploy ballistic missiles, General Groves provided his blueprint for how to do it, pretty much the one he had followed.

* Put one man in charge.

* Keep the project chief outside the White House organization.

* Define the mission and its objective simply and clearly.

* Give the chief absolute authority.

* Provide him with a small advisory committee.

* Personnel must be loyal, enthusiastic — and able.

* Use existing government organizations wherever possible.

* Use qualified private organizations.

* Compartmentalize.

* Be sensible about security.

Others have examined the Manhattan Project and such collaborative efforts as Apple Computer's creation of the Macintosh or Lockheed's Skunk Works to see what factors have worked. They conclude:

* To achieve success, start with superb and gifted people.

* It is best that they produce something tangible as opposed to working on an abstraction or an idea.

* Young people are normally more energetic, confident, and curious and thus are more likely to work harder and longer.

* It is all the better if the undertaking is driven by moral purpose. Put this special population in an isolated spot without any distractions. Living in Spartan conditions makes work the focus, with no distractions.

* This tendency to escape into the work may result in ignoring or not having the time to reflect on what is being produced.

* The cooperation of the many parts toward realizing the overall goal is essential. Ensure that those below have faith in their leaders, and make sure that the leaders have faith in those below.

Conclusion – Generic lessons from historical examples

In conclusion, while it is important to learn and apply the lessons of history, we must remain cautious about making too easy analogies. The Manhattan Project sought to solve what was essentially a large-scale engineering problem, where the solutions were based upon well-founded but largely untested theories.

Modern large-scale R&D efforts to address national problems such as climate change are much more complex. There are certain programs that address the climate change challenge that may well profit from Manhattan Project-like approaches. There is a clear need for large-scale, government-led efforts to develop "transformational technologies," such as solar and wind power. It is the technical problems that can most benefit from applying Manhattan Project lessons. A reallocation of resources is also essential. The $10 billion dollars we spend each month in Iraq could fund multiple climate change Manhattan Projects.

The social, political, and economic dimensions of the problem are much more difficult to solve. The forecasts about climate change are dire. According to one prominent environmentalist, contemporary capitalism and a habitable planet cannot coexist. I should add that James "Gus" Speth, who writes about this in his recent book, *The Bridge at the End of the World* is a founder of my organization and is on our Board. The causes of global warming and climate change go to the heart of how our society and economy operates. Any remedies must go to similar deep levels to realistically confront the challenges. Can corporations and Wall Street adjust to such dramatic changes? Are there political forces strong enough to inspire the nation to join together, to sacrifice, and work diligently to solve the problem?

A major difference from World War II is that the threat to our way of life and possibly survival is now worldwide and not just national in scope. Climate change is not just an American problem. Addressing it on a global scale could be an opportunity for international cooperation—one where the

United States, under the right conditions might organize and lead an effort on the necessary scale required for a solution.

As I understand it the Academy is considering undertaking a study on designing crash R&D projects and what the appropriate terms of reference for such a study should be. There is no lack of challenges before us. At the outset it seems a valuable exercise to examine past crash efforts to see what has worked and perhaps equally valid what hasn’t worked. I hope that my comments here this morning may have helped that process.