Ethics, Engineering and the Instrumental Plexus: an Analysis of Engineering in Light of Leonardo Polo's Philosophy of Work

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As Leonardo Polo reminds us, "Ethics is the study of action, in the self-manifestation of the human being in so far as he is a living being that is both spiritual and corporeal. All other laws of behavior are linked to the constitutive laws of the human being, that is, they are not independent of morality." (Polo 2008, 4) In all fields of human activity, such as economics, engineering, psychology, sociology, and biology, ethics plays an inherent role. In Polo's *Ethics*, one receives a two-fold lesson: Ethics penetrates all human action, and everything finds meaning in its relationship with other things. Engineering, despite initial conceptions of the field, incorporates both of these ideas into its everyday practice. This paper will examine how Leonardo Polo's philosophy of work and his notion of the instrumental plexus are connected to the work of an engineer.

Leonardo Polo's philosophy of work has a heavy emphasis on ethics. Polo recognizes that ethics is long established, but now we're seeing "a kind of disintegration of ethics, or at least the failure to apply it". (Polo 2008, 1) It is often the case now that ethics is placed second to money, success, reputation, and other temporal things. In such cases, people seem to completely ignore the spiritual component of the human being, failing to recognize that their action is intrinsically related to ethics.

A particularly important aspect of human activity is work, an action that all human beings have the capability and duty to carry out. Polo recognizes that the "human organism is made for work; it is destined to make."(Polo 2008, 27) It is in work that man finds both meaning and freedom; he exercises his freedom by choosing to work, and he finds meaning in his work by recognizing the useful role of his work in society. "Thus," Polo states, "man is lord of the world and controller of his own behavior: he is constituted this way by God. We should note the many human matters of all sorts that are clarified as soon as we start taking this into account." (Polo 2008, 30) It is for this reason that human action is intrinsically moral: there is a choice regarding how to act, for better or for worse.

A guiding principle in human action is the end of the action itself. In fact, Polo mentions that the "first factor of human action is the end. The human being acts to obtain something. From the point of view of the end, effective action has a medial character." (Polo 2008, 209) Connected to the end is the motive, which drives one to act and makes use of the resources available. When one acts, one takes into account both the motive and the end, both the resources and the consequences.

In relating different aspects of human action, there surfaces another main idea of Polo: the world as an instrumental plexus. Polo points out the human ability to relate the instruments of this world and "constitute them into a plexus. The complex of tools cannot be split up; to isolate a tool, an instrument, from the complex of instruments is to nullify their character as such." (Polo 2008, 109) An example Polo gives, closely related to his philosophy of work, is that of a miner:

> A miner occupies a place in the plexus because coal is a tool, something the human being uses in relation to other things. Coal is for blast furnaces or boilers; boilers are for producing electricity; and electricity, to provide light or to move a motor. Everything is related. (Polo 2008, 114)

One could further the example by observing that the work of a miner is related to ethics. His work is human action, which, as mentioned earlier, is intrinsically moral. In the case of a miner, he and his community will benefit from work well done through resources of good quality that are accessed and distributed in a safe manner. Thus, the quality, means, and ends of his work bear moral weight.

Now, let us enter the realm of engineering. Engineering comes from the Latin word, *ingenium*, which refers to our creative and designing faculty: the genius (*cf.* Brockman 2011, 3) Engineers develop a rigorous background of science and mathematics, which they use with other technical skills in what is called the engineering method. In the engineering method, one uses knowledge of the natural sciences to develop skills in the artificial sciences, such as assessing the problem presented, coming up with possible solutions, determining the most efficient use of resources, and organizing the execution of the proposed solution (*cf.* Brockman 2011, 3).

One might be tempted to say that ethics is not involved in the work of an engineer; engineering is merely about using problem-solving skills to produce a solution to a particular material problem or need in society. But let us recall Leonardo Polo's philosophy of work: man was made to work, and all of his action bears moral weight. Since an engineer's work is human action, which he can neglect or fulfill, do well or do poorly, and benefit or hurt his family based on where his work priorities fall, ethics most certainly plays a role in that work; an engineer must take ethics into account.

In fact, a highly emphasized document for any engineering society is its code of ethics. The National Society of Professional Engineers, for example, has its Code of Ethics accessible directly from the homepage of its website. If one were to visit its website today, one will see that the first upcoming event is a seminar titled, "Key Concepts in Engineering Ethics." Its ethical values can be summarized by the following preamble to its code of ethics:

> Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct. (National Society of Professional Engineers 2014)

An edifying example of ethical conduct in engineering is what has been referred to as "The Fifty-Nine-Story Crisis". The crisis occurred when a leading structural engineer named William J. LeMessurier discovered that the wind-bracing system he designed for the Citicorp Center was flawed, and hurricane season was only weeks away (Morgenstern 1997, 23). It was after the entire building had been completed and occupied when LeMessurier realized that the bolted joints that held the building together could only withstand strong winds when they hit the building head-on, and not when they hit the building at certain angles. Rather than ignore the problem, LeMessurier investigated how dangerous the flaws were and began the task of welding the necessary joints to increase the building's resilience, despite the extra cost. Because of the high cost of repairs—over a million dollars—and the admitting of a substantial mistake, LeMessurier risked the possibility of lawsuits, bankruptcy, and humiliation (*cf.* Morgenstern 1997, 25). Despite those risks, LeMessurier knew that the risk of disaster for those using the building was too high: a mere sixteen-year storm[1] would have the capability of causing the building to collapse (*cf.* Morgenstern 1997, 25). LeMessurier took the necessary means to ensure a much higher safety level for the building, and was praised rather than criticized for his action. In his article describing the event, Joe Morgenstern affirms, "LeMessurier's exemplary behavior—encompassing honesty, courage, adherence to ethics, and social responsibility—during the ordeal remains a testimony to the ideal meaning of the word "professional." (Morgenstern 1997, 23) Professional engineers indeed place high importance on ethics in their everyday work.

Certain aspects of engineering are also related to Polo's notion of the instrumental plexus. Albert-László Barabási, a former Notre Dame physics professor who found that everyone in the world is connected by only a few degrees of separation, points out that

> [t]oday we increasingly realize that nothing happens in isolation. Most events and phenomena are connected, caused by, and interacting with a huge number of other pieces of a complex universal puzzle. (*cf.* Morgenstern 1997, 8)

This idea that everything is connected is the framework for the engineering method: To address a complex network of things, engineers make use of systems, subsystems, and the environment to associate parts of a network together.

This approach takes its root from the phrase, "the whole is greater than the sum of its parts." Each component of the whole is unique, but it functions in union with other parts of the system in order to achieve its goal. For example, members of a soccer team occupy different positions, but all share the same objective of victory. Similarly, the different parts of an airplane all contribute to its flight. (*cf.* Morgenstern 1997, 14-15) The Citicorp Center, discussed earlier, can also be an example of a system with subsystems and an environment; the wind-bracing system is one of the many subsystems of the building, and the winds blowing against it form part of the building's environment. Considering the building further within an instrumental plexus, one can see how the configuration of the joints play a vital role in the support of a building, which—on a larger scale—brings together

[1] A storm with a one in sixteen chance of occurring in a given year.

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many people from different corporations within a city that has a prominent place in the world.

One can see that the classification of systems, subsystems, and the environment is in many ways a practical recognition that the world is an instrumental plexus of things that are interconnected. An aspect that Polo would emphasize, however, is the fact that the action of man involves free will. Consequently, any system or subsystem that incorporates man, such as tools, is incomplete without the notion of freedom. Polo's idea of a 'free system' gives fuller meaning to the engineering concept of systems.

To conclude, Polo's *Ethics* links engineering to morality and the instrumental plexus in a way that is easy to understand but often overlooked. When one understands engineering in light of Polo's philosophy of work, one can greater appreciate the work of an engineer, his responsibility to his community, and the function of his work within a plexus.

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