Papal Exhortation and Engineering Practice: Partners for a More Humane World

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Abstract: The article offers an overview of the possible relations between Pope Francis' 2020 encyclical and trained professionals working in society. The focus in this exploration is on professional engineers. The paper treats beneficial guides that engineers could draw from *Fratelli Tutti*. How to secure the "safety, health, and welfare of the public" so that individual persons both in their needs and in their desires are not elided in some consideration of corporate goals or overall public benefit is a line of inquiry along which this encyclical may help direct professional engineering practice. The papal teaching also indicates how engineers, as well as other professionals, should manifest responsibility for shaping systems that sustain cooperative societies and achieve the steady protection of the common planetary resources. Further, engineers design and create devices, structures, systems, and processes that shape the lives both of other individuals and of society itself. They do this through their individual contributions and also through the collective activities of their firms and professional organizations.

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The article considers how the regular practices and present achievements of engineering provide models for action that coheres with and advances the encyclical's teaching.

Keywords: civil society, common good, engineering, global dangers, neighbor, profession, responsibility, risk, service, solidarity

[摘要] 本文旨在概述教宗方濟各於二零二零年發佈之通諭，與在社會中工作的專業人士之間的關係。本文探討的重點，在於專業工程師，可以從《眾位弟兄》通諭中汲取良好指導，尤其是通諭中論及在維護公共安全、健康及大眾福祉時，如何能同時兼顧各人的所需及期望不被忽略，此點能為專業工程師的實務運作起指引作用。教宗之教導亦指出，工程師及其他專業人士皆肩負責任，建設具系統性的制度，為能支持社會間的合作，及達致穩定保護地球共同資源之目的。再者，工程師透過個人貢獻和工程公司及專業組織之間的合作，設計及創建設備、建築、系統及程序，從而塑造各人的作息和社會生活。本文研究工程師的常規做法，和目前所取得的成就，如何能提供行動模式以配合通諭的教導，並將之加以發展。

關鍵詞：公民社會、大眾福祉、工程學、全球危機、近人、專業、責任、風險、服務、團結

1 Introduction

The goal here is to explore the possible relations between Pope Francis' 2020 encyclical *Fratelli Tutti* and trained professionals working in society. In this exploration the focus will be on professional engineers. The term "engineers" includes individual professional engineers, companies or corporations that are engineering firms, engineering units either in other corporations or in government agencies, and professional organizations such as the Institution of Civil Engineers, Institute of Electrical and Electronics Engineers, and the Hong Kong Institution of Engineers (HKIE). First, what benefit would engineers draw from *Fratelli Tutti*? Second, how do the goals and practice of engineering indicate areas where the guides offered in the encyclical have been or could be expanded or developed in actual engineering practices?

Speaking of St. Francis of Assisi as stimulating his reflection, Pope Francis, quoting the Franciscan father Eloi Leclerc, who describes St. Francis as someone "who approaches others … to help them become ever more fully themselves" (*FT* 4). One can read the HKIE's "Rules of Conduct" for a parallel target. Each engineer should "… seek to protect the safety, health, and welfare of the public".[1] Engineers, in and through their work, craft devices, systems, and processes that shape the lives both of other individuals

1 Hong Kong Institution of Engineers, "The Ordinance and Constitution: Rules of Conduct", May 2003, Rule 4.1.

and of society itself. They do this through their individual contributions and also through the collective activities of their firms and professional organizations.

2 Persons Re-Viewed by Engineering

2.1 Our Other Selves

While many professional engineering codes of ethics, as does that of the HKIE, require the engineer to seek "the safety, health and welfare of the public", the engineering organizations may well benefit from introducing an explicit statement of the need to respect and honor "inalienable dignity of each human person" (*FT* 39). If sectors of society are relegated to the fringe because of the ways in which inequality functions, "no political programmes or resources spent on law enforcement or surveillance systems can indefinitely guarantee tranquility" (*FT* 235). Narrow focus; costly result. To recalibrate the needed focus would be advantageous to engineering practitioners in that it would direct attention not only on a mass of data that models a project's structure or system, clients' requirements, and customers' wishes, but also, and importantly, on the needs and hopes of each client, customer, and all social stakeholders. Better focus; better result.

In particular, those peripheral to the accepted patterns of the society's culture – the poor, the overlooked, the medically needy – are exposed to unexamined risks and harm (*FT* 102). Such failures bring into question the

adherence of engineering in attending to the structures and programs required to maintain the environment and secure "the safety, health, and welfare of the public". Even in terms of innovation and appropriate technology, one is unable to hear and listen to the voices of the unconsidered "outsiders" so as to learn what could be done and what could be done in a new and better way.

Fratelli Tutti makes use of several biblical texts to urge all persons and groups to patterns of attention, compassion, and appropriate action, all directed to each person, also for the environment within which all peoples are immersed. Sir 18:13, from the wisdom tradition, is cited: "The compassion of man is for his neighbour, but the compassion of the Lord is for all living beings" (*FT* 59). Professions have been established to serve the public in securing the range of shared goods – e.g. health, justice, knowledge, structures and tools for living – thus, doctors, lawyers, scientists, and engineers, to indicate only a few of the professionals contributing to the common good. So, the encyclical implies that engineers, using their own professional heritage and goals, in order to serve the public, also take into account the vector of compassion, its direction and magnitude. How do both the set of regular tasks at office and labor on-site sustain the human needs of society? How does the innovative, creative work required in and emergent from projects, create new opportunities on behalf of challenged and striving persons and groups? How do engineers converse with each other and enable discourse with other citizens and stakeholders in a

common language that facilitates and prompts keen attention toward and compassionate endeavor on the behalf of "all living beings"? The information and perspective gained through attention moves to action by way of the stance of compassion.

Considering one particular group of persons frequently overlooked, the Pope stresses the need for societies to attend to and care for migrating persons. The response of all in society to these dislocated and frightened persons, is to "welcome, protect, promote and integrate" (*FT* 129). *FT* 130 indicates practical areas where this four-part engagement with migrating people can be pursued: facilitating and protecting personal documents, housing, personal security, access to services, especially banking access and education. Exactly here is where engineers – electrical, computer, mechanical, and civil, quickly to name a few – precisely by way of their training in specialized fields, persistence in problem solving, and capacity to shape complex systems assist the vulnerable newcomers "in order to build cities and countries that … are open to differences" (*FT* 129). In addition, when the encyclical asserts (*FT* 132) that the effective response to the needs of migrating people requires global governance and long term planning, both on the basis of the professional, shared knowledge concerning the relevant technologies and also because of their transnational contacts, engineers can offer even wider, present and future assistance.

The attention to the dignity of persons, as enjoined by the Pontiff, and as consistently manifested in the stance and efforts of practicing engineers, must be articulated within and through engineering firms and organizations.

2.2 Corporate Culture and Compassion

In *FT* 20, Pope Francis indicates that the pursuit of a reduction in labor costs and the recurrent force of racism harm individuals and ranges of persons in society. Here engineers and their organizations may well consider their own stance toward labor, not as input in an accounting calculation but as the deliberate activities of persons who need both income and a sense of their own dignity achieved through work. The firms and the individuals who are engineers must consider their own stance toward diversity and the decisions resulting from that perspective. Disvaluing segments of society overlooks sources of economic value, engineering skills, and the dignity of each individual.

In *FT* 162, the pontiff declares the desired significance of work for the individual, not only because it enables the exercise of "talents and efforts", but also because work provides "a sense of shared responsibility for the development of the world". So, the fashioning of systems of production and service enable working persons to consider not simply the consequences of the employment for themselves and their families, but also for those others near and far with whom they live. Here an important note: this is or should be true of the employed, professional

engineer. Each of the professional engineering sectors and each engineering firm must educate and enable each of the colleagues to grasp the world-fashioning result of his or her efforts. Yes, environmental and climate perspectives have brought elements of this perspective to the fore. The social and governance consequences of many systems, programs and processes also (mis-)shape the world within and beyond the environment. The achievement of this professional responsibility requires discursive engagement in each firm with the voices of the all the professionals there employed.

FT 67 also offers the hope that communities "can be rebuilt by men and women who identify with the vulnerability of others … and act … as neighbours … for the sake of the common good". Here lies a special set of challenges for engineers. Yes, engineers have special training that provides them perspectives and skills by which they may contribute significantly to rebuilding the world and our communities. However, as with individuals in many other professions, they most often work in groups and organizations. Not simply as individual engineers but also as participants in working groups and companies and even in profession-wide organizations, engineering must pursue its complex roles in establishing the framework for (re-) building society. To see human vulnerabilities and then work to protect persons so that the common good comes about – this extensive task cannot be left to individual engineers. The leaders and colleagues – who work together, who draw up business plans, who interact with clients – must jointly

establish clear and firm paths (a) by which their working groups and firms recognize the vulnerabilities that the members of their cities and nation face and suffer and (b) along which paths the professional groupings pursue the common good as they come to articulate it in professional terms. Each professional engineering group and firm must establish its collective agency, its common attention to embodied social needs, and persistent efforts in research, design, and fabrication to achieve projects that move toward its society's common good.

The Pope points out two dimensions of conscience critical to the internal life of the firm. *FT* 274 addresses freedom of conscience. Firms must secure this intimate freedom within the firm even as the individual stands in regular, close collaboration with peers and superiors. Indeed, a dimension of this freedom is securing the free flow of information within the firm. Without well-formed, experienced perspectives, not only the firm, but also society lose.

FT 275 provides a warning about the desensitized conscience – one constrained only to material concerns and empirical observations, by mathematical or economic rationalities. Since engineers make a world for humans and since human persons shape their lives in the context of transcendent values, how do engineers manifest a parallel performance likewise striving for transcendent values? Which ones? Dignity has already been highlighted. Other

transcendent values, in particular justice will emerge below. These transcendent values must inform the professional conscience.

An important aspect of the potential, professional disjunction from social reality and the collapse of discourse concerns the engineers' working life as it is internal to the firm. The danger would be that a keen focus on the project at hand and swift alertness to economic challenges and opportunities can enclose a work group or the profession in a zone of like-minded colleagues. Yet this group and the individuals who constitute it – often immersed in digital network communications – are removed from the people whose world they shape, unable to engage with their concerns, unable to envision probable risks.

FT 50 notes that "Conversations revolve only around the latest data; they become merely horizontal and cumulative". This may be a danger in a firm or a working group. The issue is how to achieve genuine dialogue, committed and patient discourse. The problem is to seek and achieve this discourse in each branch of the engineering profession, in each engineering corporation or firm, in each working group, and on the part of each engineer in education or in practice. This is a multilevel problem. Engineers address and solve problems. In discourse, engineers can come "to recognize what is essential to give meaning to our lives" or, parallel to these words of the encyclical, the professionals can interpret what the public's safety, health, and welfare mean, across

generations and cultures, for their societies and, indeed, for themselves.

In its examination of the significance of the Samaritan narrative, the encyclical turns to the differential impact of perceiving other persons either as associates or as neighbors (*FT* 102).[2] Professionals benefit from being "partners in the pursuit of particular interests". The engagement of these associates, established on the basis of common interests, creates an identity the adherence to which often separates them from those outside the group. What arises on the basis of the group's collective efforts and alongside their keen efforts and achieved projects, is what the encyclical calls a structure that is "self-referential". Only those persons matter who serve the group's purpose. In terms of the Samaritan story, no neighbor can be seen, considered, and involved with. Only those matter who serve the group's purpose. *FT* 28 adds another warning that the restricted, inward-looking community fashions achievements that actually render those who are provided, dependent, having lost their "independent agency".

In those instances where such exclusive associational grouping becomes established, difficulties result for the engineering profession. Without contact with those apart from other engineers, regulators, clients and customers, engineers may overlook the impact of their project on the

2 Pope Francis acknowledges Paul Ricoeur's thought as inspiration for this consideration.

environment or may not attend to interventions by non-profit organizations. Also overlooked may be stakeholders, they who have market-linked involvement with the projects and systems created. Neglected harmful impacts damage the respect for and trust in the profession.

The Pope indeed highlights the danger that technological development can strengthen primitive human instincts in that contemporary technological walls often foster the fears and distrust that prompt divisiveness and disdain (*FT* 27). However, the same technical capacities that can construct walls also are capable of establishing actual and analogical bridges between peoples. To be sure, it is incumbent upon engineers, their clients, and their public to widen their horizons in order to view, across divides, potential sites and systems for bridging.

The pattern of internal, cooperative activity of engineering firms that the encyclical calls upon reflects the longstanding Catholic social teaching principle of subsidiarity. Further reflection in the encyclical develops another familiar principle.

2.3 Crafting Solidarity

In order to steer engineering firms and associations even toward national and international contributions, the principle of solidarity – familiar in Catholic social teaching – can provide a guide. *FT 116* states, solidarity "means thinking and acting in terms of community". Whether in

terms of considering stakeholders or in attending to the environment, this perspective on community frequently, however not always, has a place in engineering planning and projects. Solidarity "also means combatting the structural causes of poverty, inequality, the lack of work, land and housing, the denial of social and labour rights". To this specification of solidarity across a broad range of social needs, one might respond that such concerns are matters for a society's political and economic organizations. Yes, but they are also concerns to which the encyclical calls engineers to attend. The firms and institutions in which engineers participate shape the framework in which human needs are to be met. Engineering firms design the transport systems that assist or hinder the poor to reach employment, medical care, and groceries. They design the communication systems that can facilitate education and security. They construct the structures that create new land or protect threatened buildings. Engineers have now developed new practices for the manufacture of swiftly produced and affordable housing. In that engineering firms and corporations themselves are economic organizations, so, at the minimum, these potent social agents must secure the social and labor rights of all their employees and of those in their supply chains. The common good is the target. Solidarity enables collective, guiding agency. The solidarity principle entails tasks. Achieving these tasks via the skills, experience, and energy of the engineering companies and organizations moves the public closer to its communal safety, health, and well-being.

Solidarity governs not the present alone. It requires recollection so as to guide the shaping of the future. The professions and, consequently, engineering, here have a critical role. Referring to the Shoah and to the nuclear bombings of Japanese cities, the Pope extends the potent force of an attention to history by emphasizing the need to bear witness. Dangers now recognized and recalled, for example, dangers, unacknowledged in the past, caused by leaded gasoline and chlorofluorocarbons, should prompt engineers and their firms to bear witness to the past threats, to emerging dangers in the present, and likely to future risks. In this way, dangers from the past can bring engineers to work against and to warn the public about new developments whose elevated risks would harm the public. Bearing witness requires professional, calculated assessment as well as courage, personal and collective. Ideally built upon practitioners' shared articulation of its comprehensive commitment, the firm itself will manifest in its projects and public profile a witness to a world-crafting that engages in responsible development. To an analogous responsibility, the profession, its constituent elements, and its practitioners must challenge and call to account political systems.

3 Interlude – Producing "The Samaritan"

The encyclical's chapter two focuses on the Good Samaritan story from Luke's Gospel. Some usually overlooked contributions to the narrative make the story possible. The road as well as the inn were designed and

built utilizing engineering skills. The coinage used as currency required ore smelting, mold formation, and metal casting. Devices were used to fashion the textiles for the bandages. Special presses were designed and built to provide oil and grape juice. Stoneware containers also required special production skills. So, a tale that enacts achieved compassion depends upon the engineering craft of the ancient Mediterranean world. Contemporary engineers, the parable actual framework implies, can help articulate and craft systems, processes, and programs that today sustain compassionate action.

4 The Engineering of Global Neighborhoods

4.1 Civil Society

Early in the encyclical, Pope Francis, quoting his own address to the diplomatic corps accredited to the Holy See, maintains that a "sense of responsibility" toward all men and women is the basis for civil society (*FT* 40). Engineering firms and professional engineering associations are key, dynamic elements in the formation and activities of civil society. Here subsidiarity directs engineering groups in their external impact.

FT 66 declares that all persons are summoned to rediscover their "vocation as citizens of our respective nations and of the entire world" and, further, they are called to be "builders of a new social bond". So, what is needed to enable this "social bond" is a framework: buildings

and public spaces that, rather than separating and splitting persons and groups, make it possible for them to meet and engage; transportation networks the facilitate movement for all ranges of society, with minimal harm to the environment; communication systems to which all have ready access; and shared, protected systems for information gathering and data analysis to advance human learning and global intelligence. Civil, mechanical, electrical, electronic, computer and other engineers are they whose skills can create the complex framework for this "social bond" directed to achieving the common good. They along with many others in their society are its "builders".

In *FT* 77, the Pope urges each member of his audience to hopeful action. "We should not expect everything from those who govern us, for that would be childish". Within co-responsibility, all persons are called upon to "act at the most concrete and local levels, and then expand to the farthest reaches of our countries and our world" (*FT* 78). All persons are urged to work with others in community as a family. In order to sketch the organizational activity that results from this co-responsibility, the Pope turns to the principle of subsidiarity.

These subsidiary efforts within the zone of civil society constitute a vital, effective force in order to secure "coordination in complex situations" as well as to attend "to fundamental human rights and the critical needs of certain groups" (*FT* 175). Certainly, engineers resolve complex

problems by careful coordination as a regular practice in their profession. Other groups and agencies can learn from and in cooperation with engineering practice.

Here the very organization of professional contribution to society that enables the work of engineers sketches a more effective, though more complex, instrumentality for progressing toward the common good. Individual efforts coalescing through shared vision and intention form a collaborative family. For the vision and intention of the family to be maintained, a structure can develop. A neighborhood children's football league does not face shifting game rules and survives changes in coaches, players, and parents. The football league is device that enables concerned adults to move their world – here, the future physical and social capacities of their children – further along one dimension of the common good. The football league is one element in the structure of civil society. Engineering firms and organizations also are elements, albeit more potent, of civil society. Professional engineering companies enable dedicated citizens to articulate the "co" in co-responsibility in a higher, more specific, more durable manner than found in families. Yet civil society organizations are distinct from government. NGOs also are civil society organizations; many of these attentive to social needs voiced by individuals or manifest in the deprivation and suffering faced by many. Similarly, the companies and organizations in which engineers are active model the structures that can achieve the hopeful action which the Pope urges.

4.2 Pursuit of Truth

The encyclical contends that the process toward recognizing constant values, such as co-responsibility, requires discourse and consensus (*FT* 212 and 213). Scientists, engineers, and technology specialists in their research laboratories, firms, and professional organizations provide models for coming to coordinated agreement on principles. The consensual engagement takes place across national, disciplinary and cultural lines. The efforts, the struggle, through experiments, papers, conferences, and forensics, accompanied by efforts to grasp the perspective of others who disagree, yield, over time, agreement on principles. *FT* 211, mentioned just previously, says that the discursive effort makes it possible to establish a "solid social ethics". Such principled guidance toward the common good make possible proper determinations about the dangers of nuclear reactor wastes, about the stability of structures in earthquake zones, about effective means for capturing viral aerosols, about cryptographic procedures to protect privacy. The Pope urges a grasp of foundational truth. Step by step over years, across an array of social, linguistic, cultural, economic, and political divides, the discovery and discourse propelled by engineers and their professional peer models the pursuit of truth.

4.3 The Service of Disciplined Effort

The Pope points beyond historical witness to actual work activity in the present. He states that "each generation

must take up the struggles and attainments of past generations" and "that it is not possible to settle for what was achieved in the past" (*FT* 11). The aspirations for personal and social design are goals achieved through constant exertion. In the context of the professional life of engineers, the twin parameters of their hardwired practice – assiduous effort and historical perspective – enable engineers, their firms and their organization to concretize in their projects and programs transtemporal values, focused on the dignity of persons.

Pope Francis again emphasizes what is required in social movement to meet the voiced needs of a people is "an arduous and constant effort to generate the resources people need to develop and earn a living by their own efforts and creativity" (*FT* 161). The work of engineering professionals, whether measuring, error-correcting, coding, designing, analyzing for risk, etc., is indeed arduous and ongoing. Engineering uses and re-uses natural resources to provide the requisites for personal and social activities. Engineers seek both to maintain and to improve these necessary products and structures – for example, an orbiting space telescope, a hydroelectric dam, a residential tower, CT scan devices.[3] Notice that what the encyclical is urging proceeds along two lines: strenuous professional work and an historical

3 Concerning Hong Kong, for examples of engineering contributions and innovations in connection with climate, health, and other fields, *Hong Kong ENGINEER* provides up-to-date material. Cf. http://www.hkengineer.org.hk/

perspective. The engineers examine what was done, how it operates, how matters are proceeding, how to correct, maintain, or improve. This is not fast fashion or fast food. Time counts because, as this paragraph of the encyclical indicates, persons in society need years to develop, so as to manifest even their own capacity to create.

In fact, the central, systemic role of engineers is key in their contribution to social development. In *FT* 164, he emphasizes the need to conjoin the "abstract and the institutional" dimension in a process that "embraces … institutions, law, technology, experience, professional expertise, [and] administrative procedures". Here are grouped many of the day-to-day components of professional practice, including that of engineers. Moreover, the avenue along which the joining, by way of complex components of professional work travels, is "an effective process of historical change".

4.4 Forensics and Risk

At *FT* 18 the Pope writes with dismay how persons are disvalued and the resources of our world are wasted, engineering practices of forensic and risk analysis can be directed to the reversing of those twin misvalues. Likewise, Pope Francis says we are "to rediscover our vocation" as builders. In *FT* 67 he emphasizes that we are to "rebuild our wounded world". So, with respect to the future, how novel approaches and restoration of past harms can be achieved calls upon forensic and environmental engineers: the former

exercise their discipline to determine what has failed and why; the latter, along with others, strive and persist in determining how human activities have been harming our planet and what we must undertake now in our common restorative and sustainable projects.

Also at *FT* 246 the Pope returns to the values to be ascertained in an attention to history, "forgetting [past cruelty and suffering] is never the answer". The engineering profession, when adhering to the demands of its difficult practice, engages in careful forensic analysis of failure in devices and systems. The profession further directs a careful interest toward history in its discipline of risk analysis. Any project or device is exposed to endangering factors that may emerge. Their identity, force, and likelihood can be discovered by examining past developments – successes and failures – in the relevant technologies. Risk analysis can address not only expected year of pavement replacement for a surface artery, the need for seat belts, and also the likelihood of window frame failure endangering pedestrians. As a result, possible defenses or fall-backs can be designed and implemented. Attention to the past and assessment of risks thus lead to the heightened probability of benefits to persons and society. Careful engineering analyses can enable a clearer focus on and sheltering of human value.

4.5 The Endangered Global Neighborhood

With sorrow, the Pope refers to horrifying features of our present world: the production and distribution of illegal

drugs, the extensive trade in armaments, the system of organized crime at the international level. One aspect of the relevance of these devastating activities is that engineering skills have been instrumental in the production of lethal, addictive pharmaceuticals, in the design and fabrication of yet more deadly weapons, in the development of information and communication technologies that facilitate crimes and their profits. The Pope calls upon "institutions" to take "intelligent advantage of the immense resources offered by technological development" (*FT* 188).

The engineering profession, its many professional organizations, and engineering firms are such institutions, better situated than most others, to probe and prod technological development to assist in ending the named transnational wrongs. This can be done along two paths. First, the engineering organizations, each in themselves as well as in cooperation with others, can shape programs through which they explore what devices, systems, and programs can be crafted so as to assist other social, national, and international organizations to stop these powerful, criminal activities. Second, engineering organizations can address the level of government and also groups in civil society to understand that, yes, technological development can devise techniques and systems to block, restrict, and end these wrenching, distorting forces that waste and misshape the lives of human persons.

4.5.1 A Planet in Danger

Engineering operates along with other agents within civil society: certainly, a key field for action today, as has been seen in *Fratelli Tutti*, is care for the environment. The United Nations has called upon partnerships around the world to establish civil society organizations to address the Sustainable Development Goals (SDGs)[4], an extensive, international program to address the present dangers emerging within the environment, dangers that threaten persons, especially those already marginalized or faced with profound needs. At the very least, a handful of the goals – those involving food, water, energy, production, infrastructure, and cities – manifestly involve engineering. Each of the SDGs is articulated in terms of targets and indicators. Such a system designed with outcomes to be measured appeals to strengths of the profession.

But, the engineering profession has to acknowledge this role. A demanding issue for engineers is creating the means by which engineers and firms come "to look beyond" (*FT* 117 and 245) the present suppositions of business practice. This must be done both on the part of individual engineers and within work-groups and firms. The articulation and metrics of the SDGs provide materials and programs that can assist in achieving new perspectives, and subsequent commitment. Engineering professionals, exactly through

4 Concerning civil society please refer especially to Goal 17, Target 17. See https://sdgs.un.org/goals.

their own "civil institutions", can play a preeminent, intermediating role the movement of society toward the common good.

Clearly engineers (in mining, power, and agricultural fields, as examples) understand the contemporary, critical significance of sustainable development. Pope Francis presses the care for persons further. "If we are troubled by the extinction of certain species, we should be all the more troubled that … individuals or peoples are prevented from developing their potential" (*FT* 138). Of the UN's seventeen SDGs, at least eight are directly concerned with the familial, communal, and social needs of persons – for example, quality education and work. These too – in addition to still other goals that address the climate challenges and endangered life forms – call upon the skills of practicing engineers. Development depends on innovation and systems; sustainability requires analysis, planning, and evaluation. Engineering skills and practice are necessary for sustainable development. Sustainable development secures the well-being of the public, that is, of persons in their shared and private lives.

4.5.2 Health in Danger

Given the experience the pandemic has brought, the Pope points (*FT* 35) to the results consequent upon health care systems being dismantled. Systems engineering is a profession that makes use of an interdisciplinary approach to create and maintain complex systems. One field within

this profession is healthcare systems. The models and processes in systems engineering along with evidence-based design provide a toolkit whereby, given the varied global experiences of the pandemic, achievable plans for the future health care systems, whether in the developed or developing countries, can be designed and implemented. "Can be" – the skills and experience are there. Engineering professionals must come to see this set of Herculean tasks as a pressing and humane effort. Likewise, they along with responsible members of other professions, must help broad ranges of persons – in particular, those who govern – both to anticipate the need and to engage proactively to meet the foreseen demands on behalf of citizens at risk in the face of future contagions.

4.5.3 Labor in Danger

The encyclical indicates that change in "production systems" may endanger jobs. Consequently, "political systems must keep working to structure society in such a way that everyone has a chance to contribute his or her own talents and efforts" (*FT* 162). Production systems to an extensive degree require the considered and resourceful contributions of engineers. If the operations of political systems are to enable and maintain employment positions suited to the energies, talents, and hopes of a society, then engineers must be a forceful voice consistently involved in the activity of political systems to secure proper jobs in the economy. Transport systems or information and

communication technologies (ICT) as examples, without regular and sometimes discomfiting attention to engineering judgments will result in waste: of money, resources, time, and people. Engineers and their groups must recognize, claim, and act upon this significant, public role. To be sure, for the engineering profession to undertake this responsibility properly, then its associations, companies, personnel, and education must learn to attend to the workers, old and young, and the unemployed, in order to grasp what sort of employment they desire and what sort of labor conditions they find harmful. Robotics and the new supervisory technologies are now reshaping the workplace. The jobs that will be available and the quality of work conditions must provide for and secure the contribution of individuals to their world. Engineers must learn and study what achieves the safety, health, and well-being of the employed, for engineers shape the productive systems in which work takes place.

Production systems are shaped by local conditions. *FT* 51 indicates that the less developed countries "should be helped to grow in its own distinct way and to develop its capacity for innovation". Engineers persistently innovate. Their innovations today reshape production systems. The field of engineering frequently develops projects in terms of design focused on "appropriate technology". Having attended to the needs, constraints, and potentials of a particular context that shapes the lives of local stakeholders,[5]

5 "Engineers without Borders" is a group of projects that exemplifies

engineers can undertake innovation for benefits specific to the local, national futures of those persons. Consequently, the engineering profession in its heritage and skills is positioned to achieve what the Pope is urging, each country's self-respect and independence, here understood in terms of the workers' self-awareness of work contributions.

4.5.4 The Digital Danger

Through a series of paragraphs laying out the dangers of the technologies supporting digital communication, *FT* 47 says that contact with reality is lost in that these technologies can alter and disguise reality and even create sham simulacra. One result of this fictive landscape is that persons move into microcosms of the like-minded, isolated from others and their viewpoints. The importance of this for engineers is two-fold. Engineers, e.g. computer scientists, data specialists, electrical and mechanical engineers, as individuals or as working groups are the key designers, fabricators, and operators in the systems that break apart societies so their citizens no longer cooperate in their common responsibility. In the face of this current, deadly threat, to maintain by way of truthful and fair communication patterns, the stability of each society, a firmness both grounded in attention to reality and also enacted through vital discourse, engineering professionals must secure the safety, health and welfare of the public.

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such activity. See http://www.ewb-international.org/

FT 200 and 201 present a critique of social networks and media that transmit unreliable information, facilitate "parallel monologues", verbally assail opponents, and enable manipulation by powerful bodies in a range of social spheres. The result: the impossibility of discourse. This social disvalue concerns the engineering profession in several ways. Engineers designed and developed the ICT systems that shaped and established online communication and social media. In receptive communication with a range of stakeholders, forensic engineering can examine what has gone wrong and the causes for these failures. Engineering disciplines are being called upon to shield persons and cultures from the damage that these communication systems and media are now causing. To project designs for future developments that anticipate potential failures and reduce the risk that these would emerge is a pressing set of tasks for the engineering field. *FT* 205 provides the goals for beneficial design of these systems: rich engagement with other persons and groups, pursuit of the truth, service dedicated care for the underprivileged, and the development of the common good.[6] In today's complex, multi-cultural contexts, to move from violence and cynicism to trust and truth requires discourse. The framework for this can be provided by engineers.

6 Here the pontiff quotes from the Australian Catholic Bishops' Conference, Commission for Social Justice, Mission and Service, "Making It Real: Genuine Human Encounter in Our Digital World", November, 2019.

4.5.5 Weapons Danger

At *FT* 256 the encyclical addresses the threats of war in today's world. *FT* 257 notes that wars today harm the poor and vulnerable and also the environment. That is also to say, war impacts future persons and the physical world they will inhabit. *FT* 258 notes the role of technology in 21st century warfare: nuclear, chemical, biological and yet more recently developed technologies reshape warfare so that no war ever again should be called "just". Patent to see is that engineers – as well as their firms, and their professional organizations – they who develop and shape weapon technologies must conscientiously assess how to devise systems that reduce or eliminate the potential harm to civilians, to the planet, and to the common good.

Still further and, once again, challenging to the profession and its practitioners: as one sees now in the Ukraine war, the "piecemeal" (*FT* 259) reach of warfare today means that conflict in one area projects impacts even on distant populations. Systems engineering specializes in the study and optimization of project sector interactions. Such skills need to be made available on the part of the profession to politicians and diplomats so as to foresee reduce – or prevent – far-reaching conflict-precipitated harms. The technological efforts of engineers determine the design of war today and tomorrow.

What sort of conflicts emerge now shapes the future of millions of endangered persons. *FT* 261 presents Pope

Francis' impassioned plea against "the abyss of evil at the heart of war". He asks that all listen to the victims of warfare and war technologies. Certainly the engineering profession and it practitioners may sense themselves called upon here to exercise forensic analysis by way of engagement with those whose embodied selves have been mutilated or with those who have lost dear ones to death or with those who have displaced from their devastated neighborhoods and cities.

Engineers innovate. Innovation frequently emerges as a result of being caught up in a fresh perspective. Interaction with the views and stories of those who have suffered can lead to heretofore unimagined devices that lead to technologically achieved reduction or redirection or elimination of classes of weapons. Perhaps, too, one shares the Pope's hope: an end to warfare. Using a term that speaks to the heritage of practicing engineers today, the encyclical calls each person "to be an artisan of peace" (*FT* 284). Critical is how engineering firms and the profession orients itself toward this key element in the "safety, health, and welfare" of the public.[7]

For those professional practitioners reflecting on the world-wide dangers the encyclical addresses, a set of challenging questions arises concerning possible and

7 *FT 283* notes that systems of finance, weapons, logistics, intelligence, and media enable the harms caused by agents of terrorism. Thus, engineers must consider how their technical designs could prevent rather than make possible destabilizing violence.

necessary activities among the members of the discipline. So as to reduce the harm to persons and societies resulting from these grievous, threatening failures in international systems, how do engineers and their corporations come to consider, evaluate, and act? Leaders and trailblazers can urge their colleagues to design programs to travel the twin paths, internal and external. Likewise, in seeking to move further to bring engineering skills into action, individuals and firms may find it urgent to press faculty members in engineering schools to create curricula that help students, the future engineers, to understand and ally themselves with the need for their professional action in the face of these systems of global failures.

5 A Word in Closing

FT 252 surveys the activities entailed by justice. "Respect for the victims" provides the background for engineers' concern for health and safety. It also calls upon engineering's forensic skills. "Preventing new crimes" often requires the risk analysis and capacity for witness on the part of the profession. "Protecting the common good" stands as the lens for securing the well-being of the public. "The love of justice itself" presents a humane longing that can serve as a vector for engineering design.

The encyclical offers guidance that promises benefit to engineers and to the public. The skills, experience, and systems of engineering provide means for achieving the

Pope's desire to sustain all persons with dignity and care.

Members of other professions may consider themselves invited by the recommendations presented in *Fratelli Tutti* to achieve actions and patterns in their professional lives analogous to those this universal letter of the Pope suggests to the members of the engineering profession.

Engineers make the world; all of us live in it. All persons must engage their capacities to act for the common good within this world that could be one vivified by neighbors. Professionals have particular gifts and extensive responsibility in establishing the global neighborhood.