The *Faqīh* as Engineer: A Critical Assessment of *Fiqh*'s Epistemological Status

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Abstract

Following a brief discussion on the differences between science and technology as well as engineering's main characteristics, I explore *fiqh*'s epistemological features. The upshot of my discussion is that although Muslim scholars like Farabi and Ghazzali consciously placed *fiqh* in the category of "applied sciences," it seems that many of the *fuqahā'* and other Muslim (or even non-Muslim) scholars have not fully appreciated the significance of this point. The result, as I argue, has been epistemic confusion on the part of many *fuqahā'* and perhaps other Muslim scholars.

It has generally been assumed that *fiqh* has the (immediate) aim of acquiring knowledge and discovering objective truth about reality, and that by doing so it can fulfill its other purpose: dealing with practical issues. I shall argue that this misconception has contributed to some unfortunate consequences. Equating a *faqīh*, who is a practical problem-solver par excellence (i.e., an engineer), with an *'ālim*

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(a man of knowledge) has helped the *fuqahā'* further consolidate their dominant position in the ecosystem of Islamic culture. In turn, this has paved the way for the dominance of instrumentalistic/ pragmatic approaches, in contrast to truth-oriented activities, in traditional centers of learning in Muslim societies.

Keywords: *Fiqh*, Engineering, Science, Knowledge claims, Pragmatic measures, Correspondence truth

Introduction

In his *Iḥṣā' al-'Ulūm*[1] (*The Enumeration of the Sciences*), Farabi (c. 870-950) presents the first comprehensive classification of the sciences of his day. He categorized the known sciences of Islamic civilization's intellectual ecosystem into five categories:

I. Science of Language: Syntax, grammar, pronunciation and speech, poetry
II. Logic (including oratory [rhetoric] and the study of poetry)
III. The Preliminary Sciences: 1. Arithmetic: Practical and theoretical; 2. Geometry: Practical and theoretical; 3. Optics; 4. Science of the heavens: Astrology and Astronomy; 5. Music: Practical and theoretical; 6. Science of weights; and 7. Science of tool-making
IV. Physics (sciences of nature) and Metaphysics (sciences concerned with the Divine and the principles of things)
V. Sciences of Society: 1. Politics, 2. Jurisprudence (law or *fiqh*), and 3. Theology (dialectics or *kalām* [apology])[2]

Interestingly enough he refers to both *fiqh* and *kalām* as *ṣanā'ah* (i.e., a technique or technology).[3] The technology of *fiqh* enables human beings to infer and determine those issues that the Lawmaker (*wādi' al-sharī'ah*) left unspecified by referring to what is explicitly determined and to endeavor to correct their inferences according to the Lawmaker's intention.[4]

Similarly, Ghazzali (1058-1111) divides knowledge into several different but overlapping general categories in the first book of his *Iḥyā' al-'Ulūm al-Dīn* (*Revival of the Sciences of Religion*), which deals with knowledge (*kitāb al-'ilm*).[5] In each of them, further subcategories are introduced and contrasted with each other. The first category consists of two subcategories: *farḍ 'ayn* (*wājib-e 'aynī*; absolutely obligatory) vs. *farḍ kifāyah* (*wājib-e kifāyī*; conditionally obligatory).The former refers to the knowledge Muslims are obliged to study; the latter denotes knowledge that is not obligatory upon everyone.

In this case, if even one member of the community studies such knowledge, then no one else is religiously obliged to do so.

The second category contrasts two subcategories: religious (*shar'ī*) and non-religious (*ghayr shar'ī*) knowledge. This latter subcategory is divided into three further sub-categories: praiseworthy (*maḥmūd*), blameworthy (*madhmūm*), and permissible *(mubāḥ)*.[6] Ghazzali defines praiseworthy knowledge as "that upon which the activities of this life depend, such as medicine and arithmetic. They are divided into sciences the acquisition of the knowledge of which is *farḍ kifāyah* and the sciences the acquisition of the knowledge of which is meritorious though not obligatory."[7] He goes on to state:

> [Those] sacred sciences that are intended in this study are all praiseworthy (*maḥmūd*). Sometimes, however, they may be confused with what may be taken for praiseworthy but, in fact, are blameworthy. For this reason sacred sciences are divided into praiseworthy and blameworthy sciences. The praiseworthy sciences comprise sources (*uṣūl*), branches (*furū'*), auxiliary (*muqaddimāt*), and supplementary (*mutammimāt*).[8]

According to him, the sources are the Qur'an, the Sunnah (the Prophet's sayings and deeds), the agreement or consensus of all Muslim scholars (*ijmā'*), and the traditions related by the Companions (*athār al-Ṣaḥābah*). *Furū'*, which are drawn from these sources, are of two kinds: "The first kind pertains to the activities of this world and is contained in the books of *fiqh* and entrusted to *fuqahā'*, the learned men of this world; the second pertains to the activities of the hereafter."[9] Having clarified the *fuqahā'*s position, Ghazzali sates: "Upon my life I declare that jurisprudence is also connected with religion, not directly but indirectly through the affairs of this world, because this world is the preparation for the hereafter, and there is no religion without it."[10]

The above examples suggest that Muslim scholars knew that *fiqh* belongs to the applied sciences.[11] Nevertheless, it seems that the majority of *fuqahā'* have not fully appreciated the significance of this. Despite the fact that Muslim philosophers, scientists, theologians, historians, interpreters of the Qur'an, and mystics have stressed the importance of theoretical approaches for understanding Islam's core message and to live as true Muslims, it seems that as far as the majority of Muslims are concerned, theoretical deliberations have not seriously challenged the dominance of the jurisprudential approach.

As a result, to a large extent the ecosystem of traditional Islamic culture has been shaped by the dominant legalistic trend, which has badly affected its diversity and plurality and has caused it to remain severely underdeveloped. Since all legal systems, religious or otherwise, belong to the realm of technology, the dominance of legal systems implies the subordination or even the annihilation of knowledge-garnering pursuits via technological activities. But ironically, in the absence of the healthy development of such knowledge-oriented activities, technological disciplines and practices also suffer and become impoverished. The end result is the general impoverishment of the whole eco-system.

I argue here that the misconception of (at least some of) the *fuqahā'* (and perhaps some other scholars) with regard to *fiqh*'s epistemological status has played a major role in its emergence as the Muslim world's dominant intellectual discipline. Of course this epistemological deficit should not be regarded as the sole contributory factor to *fiqh*'s rise. Other causes and factors should also be taken into account, among them the political interests of powerful groups and agents along with the general public's unawareness of its responsibilities and rights in the community and vis-à-vis policymakers. However, for the purpose of the present paper and in view of the fact that social, political, and economic aspects of its ascendency have already received some attention,[12] I limit the scope of my study to the misconception of *fiqh*'s epistemic status.

In what follows, I shall briefly discuss the differences between science (knowledge) and technology in general (section 2) and argue that *fiqh* belongs to the broad category of technologies as opposed to the category of sciences (knowledge) proper. I will then expound upon the main characteristics of engineering as a particular field within the broad church of technologies (section 3), briefly explain the main characteristics of applied sciences, and argue that the meanings attached to engineering and applied sciences have changed greatly over time. While both are part of technology, the narrowed modern meaning of applied sciences now refers to a particular activity that may be regarded as only a small part of engineering in the general sense.

Engineering, however, is a far richer activity. So while engineering may once have had a more limited meaning and the scope of applied sciences may have been wider, in modern times this situation has changed rather drastically. In this respect, the *ṣanā'ah* of *fiqh* can no longer be identified as an applied science, although once that identification was quite correct. In the last section (section 4), I shall posit that *fiqh* could be regarded (with some provisos) as a branch of soft engineering. To sharpen the focus of my discussion, I clarify the differences among *fiqh*, *sharī'ah*, *uṣūl al-fiqh*, and *maqāṣid al-sharī'ah*[13] and then highlight the implications of this categorization by drawing parallels between how these two groups of experts perform their jobs.

Science and Technology: Similarities and Differences[14]

Both science and technology are socially constructed. However, despite great degrees of interaction and mutual impact, especially as far as modern science and technology are concerned, they remain distinct entities. Science, or more generally knowledge, responds to human beings' cognitive needs. All types of technologies, however, serve two main purposes: They either (1) respond to a human being's non-cognitive needs (e.g., cars, cutleries, chairs, etiquette norms, and clothes) and thus belong to this first sub-category or (2) facilitate, as tools and instruments, a human being's cognitive pursuits (e.g., telescopes, laptops, glasses, pens, cyclotrons, and universities), but cannot directly respond to our cognitive needs. Therefore, they belong to this second subcategory. Some technologies, such as mobile phones and tablets, could play both roles.

All knowledge/scientific claims are conjectural (conjectures about reality) and remain so until they are refuted. The growth of knowledge/science is achieved either by the *via negativa* or the *via positiva*. The former refers to what we learn about (some aspect of) reality by exposing and eliminating the errors of our past corroborated conjectures. For example, we no longer maintain that Earth is located at the center of the universe or that the sub-lunar realm is made of earth, water, air and fire. The latter denotes all of those conjectures that have, despite our best efforts to expose their defects, remained corroborated. Einstein's theory of relativity is a case in point. Through these dual paths, we strive to move closer to a true picture of reality. Truth, in the sense of the correspondence of our conjectures to reality, is therefore the sole aim of knowledge/science. For technology, the aim is always pragmatic (i.e., oriented toward solving practical problems).[15]

Knowledge or science claims, which are general or universal, differ from both data and information (e.g., particular entities, processes, events, or contexts). On the other hand, knowledge/science claims, even if about particular things (e.g., the solar system's composition, the Himalaya's glaciers, or the Amazon's flora and fauna) are, in principle, generalizable: What we learn about/from those particular cases can be explained in terms of general laws and used to further our knowledge about similar cases in other contexts. In other words, while data and information only provide raw material for descriptions, knowledge claims provide different layers of description *and* explanations for the phenomena under investigation.

Knowledge claims should be objective (i.e., publicly accessible and assessable)[16] which means that they differ from intuition, flashes of insight, inspiration, and private and personal experiences. Of course, as critical rationalists argue, all of these phenomena could and would pave the way to acquiring knowledge.[17] But their role in producing knowledge is vital. In the absence of these capacities, which have a substantial function in *creating* conjectures, knowledge could not perform this function.[18] But these phenomena mostly (though not exclusively) belong to what is known as "the context of discovery," namely, the context or sphere in which scientists and technologists stumble upon new conjectures as answers to the challenges introduced by reality. But "the context of discovery" differs from the "context of assessment," which is where all knowledge claims and proposed solutions are critically assessed.

Although scientists are immersed in local cultures and traditions and carry their cultural and metaphysical baggage as well as value systems, they do their best, in their quests to understand different aspects of reality, to keep their conjectures free of such external influences in order to depict reality itself as faithfully as possible. What makes this task possible is the public accessibility and assessability of scientific (knowledge) conjectures. The critical assessment of these conjectures in all fields of science/knowledge within the limits of human cognitive abilities, as well as the knowledge reservoir available to humanity at each point in time, helps conjectures produced by scientists/scholars to (as much as humanly possible) overcome their biases so that they represent reality itself. In other words, science or knowledge strives to be value-neutral.

To be value-laden is a vice for scientific (knowledge) conjectures that aim to portray reality, whether natural or socially constructed, rather than the peculiarities of the scientists/scholars' upbringing, biases, or prejudices concerning reality (unless studying such biases is the goal. But even then, the outcome ought to be objective in the sense explained above). For technologies, on the other hand, being impregnated with those values cherished by their inventors or end users is not only a virtue, but also an indispensable characteristic. Technologies ought to be user-friendly, for the more they reflect the values and pragmatic preferences of their inventors or end users, the more acceptable they will be.

Scientific (knowledge) conjectures aim to transcend particular contexts and account for each context's particularities by incorporating initial and boundary conditions in the theory's general body. Einstein's general theory of relativity is supposed to be valid throughout the universe, despite the fact that the particular form of the space-time curvature caused by the gravitational field of the black hole in our galaxy's center differs from the space-time curvature caused by a quasar's gravitational field. Technologies, on the other hand, are context-sensitive, for without proper fine-tuning a technology devised to respond to the needs of people in a specific environment or context may not work properly in other environments of contexts. For example, a car designed for Europe's cold and wet climate has to be modified appropriately before it can be used in Africa's hot and dry deserts. An astronaut walking on the Moon's surface must wear a space suit, as opposed to a tuxedo or wooly jumpers.

Another notable difference pertains to the fact that scientific knowledge is by and large cumulative, whereas technological know-how is to some extent tacit and non-cumulative. Those past scientific (knowledge) conjectures that have been successful over a long period of time and have successfully defeated our best and most effective attempts to falsify them are routinely incorporated as approximations in the subsequent and more explanatory theories. As for technologies, since part of their know-how is transferred through some sort of master-disciple relationship or acquired as personal skills, in many cases if the know-how is lost it is lost forever,[19] or at least its retrieval would be extremely difficult.[20]

The criteria for judging advances are also different. In science, the criterion of approaching the ideal of the truth about reality provides a rough (and admittedly not yet very well formalized) measure for progress.[21] In technology and engineering, where the main concern is usually devising improvements, more effective practical solutions, or more efficient machines and instruments, pragmatic considerations are more prominent.[22]

Contrary to the view held by a number of writers, including Martin Heidegger,[23] technologies do not have essences but only functions, which cause them to become individuated. Their users could add or omit functions in order to adapt them to the purposes they have in mind. For example, a person could use a chair or an umbrella as a weapon if he/she so desired. I recently came across two interesting cases in this regard: using AK-47s (Kalashnikov machine guns) to jump a car with an almost dead battery and using ordinary plastic water bottles as light bulbs.[24] Of course, each technology's ability to assume new functions is limited.

The final arbiter for science is always reality, which corrects/exposes the mistakes/shortcomings in the conjectures produced by scientists/scholars to capture some aspects of reality. For technologies, on the other hand, the users' tastes and preferences (which together form an important part of their networks of meaning) are just as important for judging the technology's desirability as are the constraints imposed by reality for judging the efficacy of its functions.

Each specific technology is identifiable as such only for those who share a network of meaning or a collective intentionality that recognizes that particular technology and its characteristic functions. For example, an Amazonian tribal member will see a laptop as a thing, not a laptop. Philosophers define such a case as the difference between "seeing" and "seeing as."[25] Seeing something as something particular is only possible for those who share in the network of meaning related to that thing.

Earlier it was suggested that the aim of science is to discover the truth about reality. At the most basic level, such truth corresponds to fundamental laws that govern reality at those levels. In the natural sciences, fundamental laws are our best guesses for capturing the fundamental *laws of nature*. It is therefore important to distinguish between these laws and the fundamental laws of science. The latter, as suggested above, are our best representations of the former. Fundamental laws are universal and valid in all contexts. In the realm of technologies, which is a realm entirely constructed by us and which is contrary to realm of science/nature, all laws are phenomenological (technological/empirical).[26]

Phenomenological laws are used in specific contexts and for particular phenomena (e.g., the classical laws of gases, Ohm's law of electric resistance in electric circuits, Hooke's law of elasticity, the laws of fluid dynamics, and Coulomb's law of the force between two electric charges). According to critical rationalists, all such laws are derivable from fundamental laws either directly or by "approximate derivation." For example, Coulomb's law is a consequence of Maxwell's equations and the Lorentz force for static charges, and the Euler equation for a perfect fluid is a consequence of the fundamental law of dynamics[27] and Kepler's law, which states that the planets' elliptical orbits can be approximately derived from Newtonian theory.[28]

While the fundamental laws introduced by science are idealized and usually operate under the restriction of the *ceteris paribus* [all or other things being equal or held constant] clause, phenomenological/technological laws are not universally valid and thus are subject to initial and boundary conditions of the contexts within which they are applied. These laws, as was suggested above, forge a link between the fundamental laws of science and technological know-how.

The difference between scientific (fundamental) laws and technological laws is important from another point of view: Scientific laws do not tell technologists what to do, but only specify the boundaries or limits of what cannot be achieved. For example, the principle of energy conservation informs technologists and engineers that it is impossible for them to construct a perpetual motion machine. Similarly, entropy suggests that they can make a machine that functions at a 100 percent efficiency rate.[29]

On Engineering

Engineering belongs to the broad church of technology. In line with the main objectives of technological activities, engineers in all fields either respond to people's non-cognitive needs or provide tools to assist scientists/scholars pursue knowledge. Nevertheless, despite sharing the main objectives of all technologies, it differs from other types of technologies. For example, politicians, managers, mayors, shopkeepers, door-to-door salesmen, and bankers are all technologists, but they are not engineers.

A third term that needs to be explained in this context is *applied science*, which, notwithstanding the label *science*, belongs to the realm of technology. Even a cursory glance at the history of ideas reveals that the meanings of *technology*, *engineering*, and *applied sciences* have changed over time. Technology is related to the Greek concept *techne*. "This concept and its Latin equivalent, *ars*, encompassed a broad range of activities—rhetoric as well as carpentry, medicine as well as sculpture."[30] "The phrase 'applied science' … had been coined by Samuel Taylor Coleridge in 1817, translating the German Kantian term '*angewandte Wissenschaft*.'"[31] The term *engineering* also has a chequered past. Since the mid-nineteenth century, when the phrase *engineering sciences* (probably as a translation of *Ingenieurwissenschaft*) was introduced into Britain, its meaning has evolved considerably.[32]

Some writers maintain that *applied science* no longer serves a useful purpose and thus should be dropped to avoid the wrong implication that it is about some sort of knowledge.[33] I agree with this sensible suggestion; however, because the term is still used by some, I suggest that one should bear in mind the following points: (1) these sciences are part of technology and have nothing to do with science/knowledge and (2) the boundary between them and engineering is not rigid. Other writers maintain that an applied scientist's main task is to ascertain whether a particular theory can be applied to a particular problem.[34] In other words, his/her task is to determine whether or not a particular problem could be deduced as one consequence of a certain theory (or technological law). To do this, he/she needs to find suitable initial and boundary conditions that can serve as the minor premises of a deduction in which the theory (or the technological law) is the major premise. However, an applied scientist can only deduce the theory's "in principle" applicability, a task that can be regarded as a small part of modern engineering.

An engineer's main task is to turn an "in principle" solution into an actual solution by relying on abilities and techniques that are highly practical and not based on rule-following procedures. A case in point is an electronic engineer who wants to construct an amplifier.[35] An applied scientist or an engineer working in that capacity would develop a model based on a deduction from theories (laws) of the circuit elements (e.g., transistors, capacitors, resistances, and inductors) that are, in turn, based on the basic laws of electromagnetics. The model, thus calculated, represents an "in principle" solution. Now, to *actually* produce an amplifier that works properly, an engineer usually makes several local changes in the calculated values of the circuit elements while taking into consideration a certain degree of tolerance for the prescribed values. In doing so, he/she deviates to some extent from the original values and design that had been developed with the help of the original theory. These changes in the model, or in any other device or system for that matter, represent the contextual and environmental requirements that the device or the system have to fulfill.

The construction of the iconic Sydney Opera House is another typical example. When Danish architect Jørn Oberg Utzon presented his plan in 1958, he had taken into account the nitty-gritties of the laws dealing with static and structural engineering. These technological/phenomenological laws were, in turn, based on the fundamental laws of Newtonian mechanics and other basic sciences. However, actually building it took the construction firm Civil & Civic, monitored by the engineers Ove Arup and Partners, fifteen years of extremely hard work and involved thousands of ingenious tricks and techniques that could not be found in any textbook.[36]

While pursuing their education and training, engineers learn a great deal of basic science and mathematics. They are then exposed to the sort of technical knowledge needed to solve problems. Since engineers deal only with practical problems, the knowledge they need differs from pure theoretical knowledge. Part of what they know can be derived from theoretical knowledge indirectly through engineering textbooks, which are full of such valuable derived knowledge that can be used to design effective devices and systems. This part of their knowledge can be termed the *knowledge of phenomenological laws*, which is the knowledge used by applied scientists or engineers working as applied scientists. Phenomenological/technological laws, as stated above, are based on the more fundamental laws of pure science.

However, engineers need more than just a knowledge of phenomenological laws in particular fields if they are to become good problem solvers. They also need to know what Gilbert Ryle, somewhat misleadingly, called *knowledge how* or *know how*, which differs from the *knowledge why* or *know why* of pure scientists.[37] *Knowledge how* is the knowledge of how to perform things, how to design an appropriate solution. Herbert Simon has explained the differences between science and engineering as "[w]hile science deals with how things are, engineering deals with what things ought to be."[38]

Knowledge how can be taught by observing a master or an expert directly or, in some cases and to some extent, by a reading the instruction booklet prepared by the relevant experts. Recipes for certain dishes; how to drive cars, swim, or make dresses; and how to operate a washing machine, a dish washer, or a camera – all of these examples show that know-how takes different shapes, forms, and degrees of complexity. To varying degrees, all people possess this type of knowledge, defined as the ability to construct or change reality. Engineers, however, are expected to apply this know-how to complex engineering systems based upon their aptitude and ability to do so. This ability very much depends upon a sound and constructive relationship between one's hands and one's mind/brain.

It also emerges after actual wresting with specific problems. Here, the guidance of a master or expert could greatly help the novice better develop his/her grasp of the particular *knowledge how* in question. But people, even when exposed to the same regime of theoretical and applied education and training, show varying degrees of mastery. A good engineer is one who has a developed vision, insight, intuition, ability, or aptitude that allows him/her to "see" the solution for a particular problem in a particular problem-situation. This ability sets him/her apart from his/her peers.

The British engineer G. F. C. Rogers states that "[e]ngineering refers to the practice of organizing the design and construction [and operation] of any artifice which transforms the physical world around us to meet some recognized need."[39] In other words, an engineer's main tasks are to organize, in the sense of devising appropriate designs for particular problems (planning and design); translate the designs into finished constructs or products (construction); and then use the constructed artifice to meet the recognized need (operation).[40] It must be emphasized here that construction does not only signify material products, but denotes non-tangible or less-tangible products, such as organizations, systems, algorithms, and a set of rules and practices.

Drawing on Thomas Kuhn's distinction between *normal science* and *revolutionary science*,[41] some writers have distinguished between *normal technology* and *normal design* and r*evolutionary technology* and *radical design*. Kuhn defined normal science as "a puzzle-solving activity,"[42] meaning a routine activity of deducing particular solutions for particular problems in light of the established laws in the particular paradigm guiding the normal scientists' activities.[43] Revolutionary science refers to the periods of radical conceptual change and paradigm shift.[44] As the above definition implies, Kuhn reduced science to applied science, which is part of technology.

Edward Constant defined normal technology as "what technological communities usually do," as comprising "the improvement of the accepted tradition or its application under 'new or more stringent conditions.'"[45] Walter Vincenti defined normal design as "the design involved in such normal technology. The engineer engaged in such design knows at the outset how the device in question works, what are its customary features."[46] But radical design is very different, for "how the device should be arranged or even how it works is largely unknown. The designer has never seen such a device before … The problem is to design something that will function well enough to warrant further development."[47]

Normal design is an evolutionary process, for improvements to the existing solutions come in a gradual and piecemeal manner. Gradual changes in the environment that are being absorbed by osmosis prepare the ground for further subtle changes to existing solutions and devices. It must be emphasized that just as in normal science, normal technology and normal design comprise the bulk of day-to-day ongoing activities in applied science, technology, and engineering. As one expert said, "For every highly innovative design engineer there are thousands of useful and productive engineers designing from combinations of off-the-shelf technologies that are then tested, adjusted, and refined until they work satisfactorily."[48]

The *Faqīh* as Engineer

To avoid any misunderstanding, I will now clarify the relationship between fiqh and several closely related disciplines and concepts, namely, *uṣūl al-fiqh*, *sharī'ah*, *maqāṣid al-sharī'ah*, *mujtahid*, mufti, and fatwa. I begin with a very general definition, which will be followed by a more technical definition when discussing the *fiqh*'s link to engineering.

> *Fiqh* is a term for Islamic law, particularly as it is interpreted and implemented by legal experts from among the *'Ulamā*. Whereas the *sharī'ah* is ideally the comprehensive body of law ordained by God, *fiqh* involves Muslims' commitment to understand God's law and make it relevant to their lives. As such, it is a religious form of what is called "jurisprudence" in the West, and it extends its reach from matters of worship to detailed aspects of everyday conduct. A member of the *'Ulamā* who is trained in *fiqh* is called a *faqīh* (jurist).[49]

A closely related notion, and one that is often mistakenly identified with it, is Shari'ah, which incorporates all of the laws introduced through the Qur'an and the Sunnah (the Prophet's saying and deeds). The Shi'ah have an additional source: the Imams. *Uṣūl al-fiqh* is a semantic-hermeneutical tool that helps *fuqahā'* formulate their expert opinions concerning *shar'ī* problems. Wael Hallaq suggests the following definition: "[A] discipline or a field of study specializing in methods of interpretation and reasoning …, with the aim of arriving at new legal norms for unprecedented cases or rationalizing existing ones."[50]

The *maqāṣid al-sharī'ah* signify the aims and objectives that the supreme Lawmaker, God, intended to be achieved by implementing the Shari'ah. Mohammad Hashim Kamali has made the following observation:

> Generally the Shari'ah is predicated on the benefits of the individual and that of the community, and its laws are designed so as to protect these benefits and facilitate improvement and perfection of the conditions of human life on earth. … The underlying theme in virtually all of the broad spectrum of the *aḥkām* is realisation of benefit (*maṣlaḥah*) which is regarded as the *summa* of the *maqāṣid*. … The *maṣāliḥ* (pl. of *maṣlaḥah*) thus become another name for *maqāṣid* and the *'ulamā'* have used the two terms almost interchangeably. The *'ulamā'* have classified the entire range of *maṣāliḥ*-cum-*maqāṣid* into three categories in a descending order of importance, beginning with the essential *maṣāliḥ*, or *ḍarūriyyāt*, followed by the complementary benefits, or *ḥājiyyāt*, and then the embellishments, or *taḥsiniyyāt*. The essential interests are enumerated at five, namely faith, life, lineage, intellect and property. … The essential *maṣāliḥ*, in other words, constitute an all-encompassing theme of the Shari'ah as all of its laws are in one way or another related to the protection of these benefits. These benefits are an embodiment, in the meantime, of the primary and overriding objectives of the Shari'ah.[51]

Fiqh is also related to *ijtihād*, a procedure undertaken by a learned jurist or a *faqīh* that applies *fiqhī* and *uṣūlī* methods of interpretation and reasoning to derive appropriate fatwas from the Shari'ah. The person who does this is known as a *mujtahid*. This term is mostly (though not exclusively) used by Shi'is; Sunnis use *mufti*. *Fuqahā'*, *mujtahid*s, and muftis are ranked in a hierarchical manner.[52]

From the above, it is clear that none of these briefly introduced terms, concepts, practices, and disciplines deal with Muslims' cognitive/epistemic needs in a direct way. Rather, they all respond to Muslims' non-cognitive needs or (possibly) facilitate (as tools and instruments only) their cognitive pursuits. In this sense, they all belong to the general category of technology.[53] Among these technologies, *fiqh* has a particular status. I will now discuss this status.

My contention that a *faqīh* is an engineer can be better understood if we compare both of their tasks. In his *Qawā'id- Fiqhī* (*The General Rules of* Fiqh), Mahmoud Shahabi defines *fiqh* as:

> *'ilm* [sic.] *fiqh* has been established to discuss the five types of rulings related to prescribed duties (*ahkām taklīfī*) (namely, obligation (*wujūb*) recommendation (*istiṣḥāb*), prohibition (*ḥormat*), discouragement (*kirahat*), and permissibility (*ibaḥe*)) and the declaratory or conventional laws (*ahkām wad'ī*) (such as being a cause (*sababiyat*), being a condition (*shartiyat*), being an obstacle (*māne'iyat*), validity (*ṣihat*), and non-validity (*fisad*)).[54]

Both of them deal with practical issues. In addition, the categories determining the boundary of a *faqīh*'s activities, namely, the five types of religious duties, resemble those that determine the boundary of engineering activities.[55] The same could be said about a physician or a surgeon, for all of these people deal with practical problems for particular problem-situations and are involved in the triad processes of normal design, construction," and operation/application.

Many Muslim scholars have noted that *fiqh* and medicine are, to some extent, similar. The contrast between *al-ṭibb al-ruḥānī* (spiritual medicine) and *al-ṭibb al- jismānī* (corporeal medicine) is a constant theme in Islamic culture. In his *Iḥyā' al-'Ulūm al-Dīn*, Ghazzali, after defining *fiqh* as a type of [applied] science, like medicine, whose acquisition is conditionally obligatory (*fard kifāyah/wājib kifāyī*), pre-empts a possible objection to his approach via an imaginary dialogue with his reader:

> If you should say, "why have you regarded medicine and jurisprudence in the same way when medicine pertains to the affairs of this world, namely the welfare of the body, while upon jurisprudence depends the welfare of religion …?" then know that … in fact the two sciences differ. Jurisprudence is superior to medicine on three counts; first because it is religious knowledge and unlike medicine, which is not religious knowledge, jurisprudence is derived from prophecy; second, it is superior to medicine because no one of those who are treading the road to the hereafter can do without it, neither the healthy nor the ailing; while on the other hand only the sick, who are a minority, need medicine; thirdly, because jurisprudence is akin to the science of the road of the hereafter, … .[56]

His argument for *fiqh*'s superiority over medicine is interesting in that it shows an epistemic attitude that does not favor temporal sciences and technologies. Such an attitude, which can be seen both among *fuqahā'* and mystics

(Ghazzali belonged to both groups) has had a continuous and seriously negative impact upon the healthy development of science and technology in Islamic culture's ecosystem.[57] The negative epistemological impact of *fiqh* being the most prestigious discipline is exacerbated by the fact its practitioners' power and social status have caused the majority of Muslim seminary students to regard it as the most attractive discipline. Thus other disciplines of "the Islamic sciences" did not receive the attention they deserved. But Ghazzali's argument, regardless of its epistemic attitude, cannot conceal the fact that *fiqh*, like medicine, is a type of engineering.

One can also argue that like engineers, *fuqahā'* attend to specific problems that respond to people's non-cognitive needs or facilitate their cognitive needs within the sphere of religious outlook and network of religious beliefs. For example, *fiqh* explains how to perform the required ablutions and prayers, fulfill the pilgrimage, conduct business transactions, and many similar issues according to the general rules of *fiqh* and *masā'il al-fiqh* (problems of *fiqh*). These rules and problems resemble engineering's phenomenological laws and, in turn, are "derived" from the main sources, namely the Qur'an, the Sunnahs of the Prophet and Imams (the latter for the Shi'ahs only), *'aql* (intellect), and *ijmā'* (consensus of the jurists).

Importantly, the differences between the *fiqhī* schools have no impact on the general nature of this practice as a branch of soft engineering. Any differences that might appear in their fatwas pertain to the specific content of their specific rulings. However, there are differences in terms of general methodology and epistemology. To better appreciate this point, consider the following example: German, Japanese, American, and Russian mechanical engineers produce many types and models of cars, but all of them, regardless of their varied appearances and efficiencies, obey the same phenomenological/technological laws. In other words, these differences are due solely to the engineers' implementation of ame laws in tandem based upon their own personal social, economic, and cultural considerations.

Both a *faqīh* and an engineer are trained to acquire the basic tools for practical problem-solving. He (mostly he, since there are very few female *faqīh*s, *mujtahid*s, and muftis) is not trying to solve fundamental epistemic or abstract doctrinal issues, for his concern is purely practical. And yet he can only solve practical problems if he has acquired a certain level of theoretical background knowledge (e.g., doctrinal, theological, philosophical, historical, and even scientific) with respect to the problems in question.

Like engineers, *fuqahā'* adjust their solutions to the problem-situations and the contexts within which they are expected to be used. For example, religious edicts concerning prayer and fasting in places like Scandinavia differ from the same edicts for places nearer to Saudi Arabia. A recent dispute over fasting during long, hot summer days brought differences among the Iranian *fuqahā'* into sharp focus. An edict issued by Ayatollah Bayat Zanjani declared:

> With reference to the *mawthawqih* (trusted news) of 'Ammar and the report (*rawāyat*) of Mufaddal ibn 'Omar of Imam Sadiq which is included in the chapter 16 of *Wasā'il al-Shi'ah*, in the section entitled "The One Whose Fasting Is Correct," those who fast but cannot endure thirst can drink water, but only to a minimal extent that quenches their thirst. In this case, their fasting is not invalid and does not need to be repeated.[58]

In an explicit and unexpected reaction to the above edict, Ayatollah Makarem Shirazi warned the public that such fatwas should be ignored.[59] Similarly, Yusuf al-Qaradawi's *fiqhī* ruling for Muslim minorities in Europe, which permits them to connect *ṣalāt al-ẓuhr* and *ṣalāt al-'aṣr*, as well as *ṣalāt al-maghrib* and ṣ*alāt al-'ishā'* by performing the second prayer *immediately* one after the first one, has generated controversy among the more traditional Sunni *fuqahā'* and muftis.[60]

Such rulings belong to an emerging branch of *fiqh* known as *fiqh al-aqallīyāt* (the jurisprudence of Muslim minorities)[61] and more vividly demonstrate the contextual nature of a *faqīh*'s activities. Another example is Ayatollah Sistani's collection of fatwas for his followers living in the West.[62] The nuances of these religious edicts are not always the same for those of his followers who live, for example, in Iraq. This reality clearly shows *fiqh*'s pragmatic nature, some of which is seen in the way *fuqahā'* change their fatwas in response to changing circumstances or even to changes in their own considerations.

Said Fares Hassan discusses one such example in the case of Qaradawi, who has given two completely different fatwas to two almost identical religious question, namely, if a Muslim living in a non-Muslim environment can accept the invitation of his non-Muslim friends, neighbors, or colleagues.[63] A more recent example is the change in the fatwa issued in 2005 by Egypt's then grand mufti Ali Gom'a (Jom'a) as to whether Muslim men can attend a prayer led by a Muslim woman.[64]

Like engineers, some *fuqahā'* are sharper than others and more competent in producing effective solutions. The nuances contained within their edicts with regard to the same problems are therefore the result of two sets of factors: individual ability and, as suggested above, the particular problem-situations with which they deal. A *faqīh*'s socioeconomic background and his intellectual and cultural upbringing, as well as the milieu in which he operates, also influence his proposed solutions. Ayatollah Motahari highlighted this issue thus:

> If one compares the fatwas of *fuqahā'* and also takes into consideration their personal history and their attitude toward real life issues, one would see that how the *faqīh*'s background knowledge and his information and understanding of the real world influence his fatwas. To the extent that the edict of an Arab *faqīh* has the smell of Arab, and the fatwa of a non-Arab has the smell of non-Arab, the edict of a rural *faqīh* has the smell of rural areas and the fatwa of an urban *faqīh* has the smell of urban areas.[65]

An example here is the differences between the views of the Lebanese *mujtahid* Ayatollah Seyyed Hossein Fazlullah and the Iraqi *mujtahid* Ayatollah Seyyed Sadiq Shirazi. The former maintained that self-flagellation and using blades during the mourning ceremonies in ʻAshura is forbidden, whereas the latter ruled that such acts are recommended.[66]

Engineers distinguish between *optimization* and *satisficing*. The latter term refers not to the best solution, but to the one that is satisfactory.[67] To some extent, this resembles the difference between two types of *fiqhī* edicts, namely, *wājib* (obligatory), which indicates that the *faqīh* thinks he has reached an ideal understanding of the relevant religious verdict, and *al-iḥtiāṭ al-wājib* (obligation to exercise caution in applying the edict), which implies that he doubts its correctness. Thus he allows his followers to follow another fatwa that might be more satisfactory in their particular circumstances. A case in point is those fatwas that regard the People of the Book (Ahl al-Kitāb) as *ṭāhir* (clean). For followers of these fuqahā' who happen to have an Ahl al-Kitāb stepmother or a stepfather, living under one roof with their parents would become almost impossible. In such cases, if the *faqīh*'s fatwa is *al-iḥtiāṭ al-wājib,* then the follower could turn to another *faqīh* who regards the Ahl al-Kitāb as *ṭāhir*.[68]

Like engineers, *fuqahā'* can produce effective solutions only if they use more than mere conceptual frameworks and intellectual arguments. For instance, they often need to reconstruct the problem-situation to get a better grasp of the issues and the proposed solutions' suitability. The story of Allameh Hilli (1250-1325) and his edict concerning the uncleanliness of well water is relevant here. Until his ruling, all Shiʻah *mujtahid*s had held that if a dead animal were found in a well, a certain amount of its water had to be removed before the rest of it could be regarded as clean and fit for drinking or washing. Allameh, however, opined that this ruling was only recommend and preferable. When faced with this very situation, he ordered his servants to cover the well and not to use its water so he could study the problem-situation without any self-interest. After this procedure, he decided that his earlier ruling was sound.[69]

The majority of *fuqahā’* and engineers are engaged in “normal design” activities, meaning that they use their expertise to gradually improve upon existing solutions or introduce other solutions based on a new arrangement of the existing know-how or solutions to the known problems. A case in point is the fatwa of Ayatollah Sane‘i concerning a new type of *ghusl* (a type of religious ritual of washing) called “the *ghusl* in lieu of *wudu*” (obligatory washing ritual before daily prayers).[70]

In contrast to the “normal” *fuqahā’*, the number of founding jurists (*al-fuqahā’ al-mu‘assissūn*) is very limited. Founding jurists are those great innovative individuals who deal with issues that have no precedent and are of great importance and gravity. These innovative *fuqahā’* suggest groundbreaking solutions and thus pave the way for substantial conceptual development. The founding *mujtahid*s of the four Sunni schools are good examples of this second category. A more recent example of a founding jurist is Ayatollah Khomeini, who developed the theory of “the guardianship of the *faqīh*” and issued some revolutionary edicts with regard to the role of an Islamic government. One such edict was that the government can oblige the faithful to abandon their routine religious duties (e.g., daily prayers or hajj) for as long as it deems doing so to be necessary.[71]

Even a cursory glance at the collections of religious edicts, known as *majmū‘ fatāwā* among the Sunnis and *tawḍīḥ al-maṣā’il* among the Shi‘ahs, clearly shows that these texts, which resemble the handbooks and manuals published by engineers to teach the end users how to operate various devices, machines, or systems, always undergo subtle changes. This is to be expected, because some instructions become obsolete due to changes in the intellectual and technological/practical environments and new instructions are added to deal with new issues (*al-masā’il al-mustaḥdithah*). Two examples here are atoning for one’s sins by freeing a slave (now irrelevant) and the acceptability of IVF treatment for barren couples (a new issue).

Another similarity between *fuqahā’* and many engineers is that they both, rather mistakenly, think that they rely on inductive reasoning for devising solutions.[72] In both disciplines, problems at the higher level of abstraction are more conceptual and relatively less structured, whereas those at a lower level are more or less well-defined. The influence of the ambience and environment is greater at the upper levels of the design process in both *fiqh* and engineering, whereas the influence of the context on this process at the lower levels is usually minimal.

Another important similarity is that both groups seek to achieve certainty. This is not a goal for theoretical researchers, however, because they are only concerned with epistemic value. Certainty belongs to the realm of personal psychology[73] and thus only confirms/affirms what one already knows. The following example is instructive here. Suppose an individual has booked a flight to Makkah. The airline has informed him/her of the relevant details. Now, if a day before the flight he/she contacts the airline and asks them to confirm the flight's details, assuming that nothing has changed, their response does not add an iota to the passenger's knowledge about the flight, but only provides psychological reassurance. To achieve certainty, engineers usually increase the margin of safety well beyond the calculated values, whereas *fuqahā'* rely on their subjective sensitivities in light of acquiring more confirming evidence.

One point that needs to be clarified here is that *fuqahā'* famously claim that the "task of *faqīh* is to obtain expert knowledge (know-how) about *fiqhī* topics and not their specific instances." This is reflected in how they formulate their fatwas, which usually take the form of a hypothetical statements: "If what is stated in the question (*istiftā'*) is the case, then the fatwa (*ḥukm* [judgment]) would be …" On this basis, some may argue that their approach differs from that of the engineers. But a closer look at the issue shows that this claim is incorrect.[74]

Unfortunately, the expression "identification of topics rather than instances" is misleading. This is a good example of what Wittgenstein identifies as the misleading power of language and against which he warns.[75] This means that the *faqīh* is responsible for resolving specific problems (topics) in a general fashion. How his believers or followers do or do not apply the proposed solution is not his concern. However, one must realize that it is usually hiss followers who bring these problems (and topics) to his attention. When a *faqīh* himself identifies a problem (topic), he does so as a believer who has come across the problem, just like his followers. But unlike them, he is obliged to devise a general solution.

Engineers follow this same procedure. For example, understanding that people needed to wash their clothes, they came up with the general solution of manufacturing washing machines. They provide the necessary instructions and then leave it up to the end users (their "followers") to adjust the solution and its accompanying instructions to their particular contexts (e.g., where to place or use it), with which they do not interfere. After all, they cannot imagine all of the possible contexts. Incidentally, in recent decades and due to a better appreciation of diverse contexts, appliance manufacturers ask their end users about their own contexts so that they can adjust their appliances accordingly. This resembles applying fatwas to various contexts. The fatwas concerning fasting in different geographical locations is a case in point.

In other words, both groups are interested in devising generic solutions in which the general limits of potential solutions, as opposed to specific cases in which the solutions can be used, are determined. The number and diversity of such cases are indeterminately large. Even in the case of specific solutions, such as constructing a bridge over a river, engineers only issue general instructions, for example, the maximum weight or height of the load. It is then up to the end users to choose how to meet their particular needs within the limits set by the engineers: the shapes of the boxes used to transport their goods, which type of vehicle to use, and when they can cross the bridge. The possibilities are infinite, and the engineers bear no responsibility for telling the end users what to do in each case. This is also true for the *fuqahā'* – they can instruct those who are fasting that they should stop eating before *fajr* (dawn), but not when to begin their pre-fast meal, exactly when to stop, which body posture to adopt while eating, what to eat and drink, whom they can eat with, and so on.

Conclusion

If the arguments presented here are sound, then their implications for the discipline or practice of *fiqh* will be significant. The first immediate consequence is that if the *faqīh* is to be effective, he must constantly improve his knowledge and awareness of local and particular problem-situations and contexts. If an engineer is assigned to construct a dam on a particular river, he must have a first-hand understanding of the relevant requirements. Unlike a theoretical scientist, he cannot discuss the issue in terms of abstract theoretical models. And unlike an applied scientist, he cannot apply those models by relying on approximations with regard to the initial and boundary conditions. He must travel to the region, fully familiarize himself with the situation, and then do his best to adjust the existing theoretical and applied knowledge to the task's specific requirements.

In a similar way, if a *faqīh* living in Qom or Najaf or Cairo or Makkah is asked how believers living in a remote part of the globe with totally different conditions should fulfill their religious duties, he cannot simply rely on the customary rulings; rather, he must make sure that he fully understands the relevant conditions and adjust his rulings accordingly. I have had first-hand experience in dealing with Muslims born and raised in the West who are seriously dissatisfied with the rulings issued by *fuqahā'* and *mujtahid*s who live thousands of miles away in completely different cultural and environmental settings and yet pass rulings on their particular situations. Some of these Muslims talk quite openly about the need for producing home-grown *mujtahid*s and *fuqahā'* who will have a first-hand awareness of the problems that they face.

A second implication is that given the ever-increasing complexity of these new problems, all competent engineers have realized that they can be effective only if they keep up with scientific and technological developments. If a *faqīh* is an engineer, he also must ensure that he is well-versed about these same changes. For example, a *faqīh* who knows nothing about modern banking cannot possibly produce a sensible fatwa on such modern business contracts as futures, swaps, collateral debt obligations, and other types of derivatives. Similarly, a *faqīh* who is insufficiently educated about modern developments in genetics, proteomics, molecular biology, cloning, neuroscience, and similar fields will be completely unable to issue informed fatwas on any of the countless problems emerging from these developments.

The last, though by no means the least, implication is that if *fiqh* belongs to the broad church of engineering, then just as each major field of engineering is divided into many sub-specialties and engineers are trained as specialists in specific areas, *fiqh* should also move toward specialization and the *fuqahā'* should begin specializing in sub-categories that deal with a specific range of highly specialized issues. Given the incredibly fast pace of change in almost all spheres of modern life, which is mainly driven by scientific and technological change, it seems that if the "technology" of *fiqh* does not adapt itself, it will be in danger of becoming an obsolete technology that can no longer offer any meaningful or applicable services.

Endnotes

1. I have also dropped the definite article *al* from the names of all non-Arab authors. Hence Farabi rather than al-Farabi.
2. Farabi, *Iḥṣā' al 'Ulūm*, ed. Osman Amin (Paris: Dar Byblion, 2008). The above quote is from S. H. Nasr, *Science and Civilization in Islam* (Chicago: ABC International Group, 1968/2001), 60-62, with some revision based on the original Arabic text.
3. Farabi, *Iḥṣā'*, 85. As stated earlier, section 2 deals with the notion of technology. It will become clear that *technology* is a correct translation of *ṣanā'ah*.
4. Ibid.

5. Ghazzali, *Iḥyā' al-'Ulūm al-Dīn* (*The Revival of the Sciences of Religion*), book 1, "The Book of Knowledge," trans. Nabih Amin Faris (Lahore: Islamic Book Service, 1962), 23-40. This text is available online at http://www.ghazali.org/site/ihya.htm.
6. Ibid., 30.
7. Ibid.
8. Ibid., 31.
9. Ibid.
10. Ibid., 33.
11. For the accurate characterization of this term, see section 2.
12. See, for example, Muhammad Qasim Zaman, "The 'Ulamā and Contestations on Religious Authority," in *Islam and Modernity: Key Issues and Debates*, ed. Khalid Masud, Armando Salvatore, and Martin van Bruinessen (Edinburgh: Edinburgh University Press, 2009); Nikki R. Keddie, "The Roots of the 'Ulamā's Power in Modern Iran," *Studia Islamica* 29 (1969): 31-53; Said Amir Arjomand, ed., *Authority and Political Culture in Shi'ism* (New York: State University of New York Press, 1988); Linda S. Walbridge, ed., *The Most Learned of the Shi'a: The Institution of Marja' Taqlid* (Oxford: Oxford University Press, 2001); Knut Vikør, *Between God and the Sultan: A History of Islamic Law* (London: Hurst, 2005).
13. I should like to thank an anonymous referee of this journal for bringing to my attention the need to deal with these different categories and for his/her other useful comments.
14. This section draws heavily, but not exclusively, on my "How Indigenous Are 'Indigenous Sciences'? The Case of Islamic Sciences," in *Asia, Europe, and the Emergence of Modern Science: Knowledge Crossing Boundaries*, ed. Aron Bala (London: Palgrave, 2011) and "A Critical Assessment of the Programmes of Producing 'Islamic Science' and 'Islamisation of Science/Knowledge,'"*The International Studies in Philosophy of Science* (2015). Both it and, in fact, the whole paper are informed by critical rationalism, a philosophical approach originally introduced by Karl Popper. See, for example, his *Conjectures and Refutations* (London: Routledge, 1963/2002) and *Objective Knowledge* (Oxford: Oxford University Press: Oxford, 1979). It was developed further by other philosophers, the most important one being David Miller, in his *Critical Rationalism: A Restatement and Defence* (Chicago: Open Court, 1994) and *Out of Error* (Surrey, UK: Ashgate, 2006).
15. Of course, in the final analysis all successful pragmatic measures owe their success to their connection to truth and reality. See Popper, *Conjecture* and Roger Trigg, *Reality at Risk* (Sussex, UK: The Harvester Press, 1980).
16. Ali Paya, "The Misguided Conception of Objectivity in Humanities and Social Sciences," in *The Crisis of the Human Sciences: False Objectivity and the Decline of Creativity*, ed.Thorsten Botz-Bornstein (Kuwait: Gulf University for Science & Technology Publications, 2011). Of course an individual may have subjective knowledge, but such knowledge is, first of all, of no use for the public because it

is by definition subjective. But second, and more importantly, given that it cannot be properly assessed in the public arena its representativeness of the truth about reality remains uncorroborated, or at least not properly examined.

17. Popper, *Conjectures & Refutations*; Ali Paya, Analytic Philosophy: Problems and Perspectives (Tehran: Tarh-e Nou, 2015).
18. Ibid.
19. Language is a good case in point. When the last native speaker of a particular language dies, the way it is spoken by its native speakers is lost forever.
20. Joseph Agassi, *Technology: Philosophical and Social Aspects* (Dordrecht: Reidel, 1985). It must be stressed that what is said in the text does not entail that technological progress does not benefit from past experiences and a gradual process of improving upon earlier technologies. Since technologies ought to respond to the needs of users in specific contexts, adjusting them to these contexts usually requires some personal touch, finesse, and adeptness that, contrary to scientific knowledge, are not part of an objective and detached World 3. World 3, as defined by Popper in his *Objective Knowledge*, is the abode of all ideas and thoughts constructed by human beings and made publicly available. Scientific theories, blueprints of technological inventions, rules and regulations, music and melodies, movies and paintings, novels and myths are all inhabitants of the world. World 3 complements two other worlds, namely, World 1, which represents physical reality (and perhaps beyond), and World 2, which the signifies subjective cognitive and emotive capacities of each individual.
21. Sjoerd Zwart, *Refined Verisimilitude* (Dordrecht: Springer, 2001).
22. As suggested earlier, in the final analysis pragmatic considerations rely on the notion of truth for their credibility: An effective instrument is the one that remains true to its design, assuming that the design itself is correct and free from errors of judgment.
23. Marin Heidegger, "The Question Concerning Technology," *Basic Writings* (London: HarperCollins, 1993).
24. (1) http://www.youtube.com/watch?v=AWI8DkQ8Zdg and (2) http://www.bbc.co.uk/news/magazine-23536914.
25. Ludwig Wittgenstein, *Philosophical Investigations*, II. xi (Oxford, UK: Blackwell, 1953/2009), 193-229.
26. David Miller, "Putting Science to Work," 2009, available at: http://www2.warwick.ac.uk/fac/soc/philosophy/people/associates/miller/oxdocs/science-tech.pdf; Ali Paya, "Do the Fundamental Laws of Physics Furnish Us with a Faithful Picture of Reality?" in Ali Paya, *Analytic Philosophy from the Perspective of Critical Rationalism* (Tehran: Tarh-e Naqd, 2015.
27. Michel Le Bellac, et al., *Quantum Physics* (Cambridge: Cambridge University Press, 2006), 11.
28. Grigor A. Gurzadyan, *Theory of Interplanetary Flights* (Amsterdam: Overseas Publishers Associations, 1996); Nicholas Maxwell, "The Need for a Revolution in the Philosophy of Science," *Journal for General Philosophy of Science* 33 (2002).

29. Miller, "Putting Science to Work," 2013.
30. Eric Schatzberg, "From Art to Applied Science," *Isis* 103, no. 3 (2012): 556.
31. Robert Bud, "'Applied Science': A Phrase in Search of a Meaning," *Isis* 103, no. 3 (2012): 537-45.
32. Ronald Kline, "Construing 'Technology' as 'Applied Science': Public Rhetoric of Scientists and Engineers in the United States, 1880-1945," *Isis* 86, no. 2 (1995): 194-221.
33. Miller, "Putting Science to Work," 2009.
34. To complete this part, I have mainly relied on Joseph Agassi, "The Confusion between Science and Technology in the Standard Philosophies of Science," *Technology and Culture* 7, no. 3 (1966): 348-66.
35. In her *How the Laws of Physics Lie* (Oxford: Oxford University Press, 1983), 101-12, Nancy Cartwright gives a detailed account of the steps that need to be taken from theory to practice in order to construct an amplifier. I have benefitted from her example.
36. The story of this iconic building's completion can be studied on the Sydney Opera House's webpage: http://www.sydneyoperahouse.com/the_building.aspx.
37. Gilbert Ryle, *The Concept of Mind* (London: Hutchinson, 1949), 41.
38. Herbert Simon, *The Sciences of the Artificial* (Cambridge, MA: The MIT Press, 1969). Quoted in David Channell, "Special Kinds of Knowledge," *Science*, 253: 5019 (1991), 573.
39. G. F. C. Rogers, *The Nature of Engineering: A Philosophy of Technology* (London: Macmillan, 1983), chap. 3. Quoted in Walter Vincenti, *What Engineers Know and How They Know It* (Baltimore: The John Hopkins University Press, 1993), 6. I have relied heavily on this book to complete part of the arguments made in this section and the next. In the above quote I made a slight change to what he had added in the bracket to the original quote.
40. Ibid., 6.
41. Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1971).
42. Ibid.
43. Kuhn identified the main aspects of normal science as follows: (1) increasing the precision of agreement between observations and calculations based on the paradigm, (2) extending the scope of the paradigm to cover additional phenomena, (3) determining the values of universal constants, (4) formulating quantitative laws which further articulate the paradigm, and (5) deciding which alternative way of applying the paradigm to a new area of interest is most satisfactory. Ibid. Quoted in John Losee, *A Historical Introduction to the Philosophy of Science* (Oxford: Oxford University Press, 2001), 198.
44. Kuhn, *The Structure*.
45. Edward Constant, *The Origins of the Turbojet Revolution* (Baltimore: The Johns Hopkins University Press, 1980). Quoted in Vincenti, *What Engineers Know*, 7.
46. Vincenti, *What Engineers Know*.
47. Ibid., 8.

48. Ibid.
49. Juan E. Campo, *Encyclopedia of Islam* (New York: Facts on File, 2009), 238.
50. Wael B. Hallaq, *An Introduction to Islamic Law* (Cambridge: Cambridge University Press, 2009), 177.
51. Mohammad Hashim Kamali, *Maqāṣid al-Sharī'ah Made Simple* (London: The International Institute of Islamic Thought, 2008), 1-4.
52. Roughly based on Hallaq, *Introduction*, 173 and 175. With regard to the Sunni conception of a *mujtahid*, Hallaq writes: "*Mujtahid*s are of various ranks, the highest of which is reserved for the one who is said to have fashioned the very methods and principles that he and others in his school apply, while those who are loyal to, and capable of applying, these principles belong to lower ranks." (Ibid., 175). The highest ranking *mujtahid*s are the founders of the Shafi'i, Hanbali, Maliki, and Hanafi schools. Among the Shi'ah, the highest ranking *mujtahid*s are called Ayatollah and *Ayatollah al-'Uẓmā* (Grand Ayatollah).
53. It is worth emphasizing that any religion, including Islam, can be regarded as comprising two main parts: ontological-epistemological and technological. The first part comprises two short statements: (1) The whole realm of being has a Lord or Master, and (2) Human beings can, in principle, know the Lord or Master of the realm of being. These two short statements, which of course need to be unpacked to reveal their indefinite depth of meaning and information, constitute the main metaphysical and epistemological aspects of religions. The second aspects of all religions are their rituals, legal advice, and ethical prescriptions, all of which belong to the realm of technologies, as defined in the text. These "religious technologies" manifest the general functions of all technologies in a religious context by responding to the believers' non-cognitive needs (e.g., hajj or zakat, which help strengthen social solidarity) and by facilitating (as tools) Muslims' quest for drawing closer to God and knowing Him better. I have discussed religious technologies in several papers, among them "Religious Technology: Approaches and Challenges," *Journal of Methodology of Social Sciences and Humanities* 18 (winter 2013) and "A Critical Assessment of the Notions of 'Islamic Science' and 'Islamisation of Science/Knowledge,' *International Studies in the Philosophy of Science* 30, no. 1 (2016).
54. Mahmoud Shahabi in his *Qawā'id- Fiqhī* (Tehran: Farbod Publications, 1962), 6.
55. It should be noted that a *faqīh*'s fatwa also applies to him, and thus he should observe the above five categories as well. In this way the *faqīh*, like the engineer, is bound by them.
56. Ghazzali, *Iḥyā' 'Ulūm al-Dīn*, 39.
57. In his *Mafhūm al-Naṣṣ* (Beirut: Markaz al-Thaqafa ql-'Arabi, 1990), chap. 3, Nasr Hamed Abu Zayd discusses some of the negative aspects of Ghazzili's epistemic attitude.
58. http://www.bayatzanjani.info/.
59. www.khabaronline.ir/detail/303603/culture/religion.

60. Yusuf al-Qaradawi, *Fī Fiqh al-Aqallīyāt al-Muslimah*, 77-79. For the controversy over his fatwa, see http://www.islamoday.net/bohooth/artshow-86-108130.htm and http://www.azahera.net/showthread.pht?t=5564. Militant Salafis had accused him of "innovation," There were a number of articles against him on their main website, namely, allaahuakbar.net; all of them have been removed. See John Esposito, *The Future of Islam* (Oxford: Oxford University Press, 2010) and Barry Rubin, *The Muslim Brotherhood: The Organization and Policies of a Global Islamist Movement* (London: Palgrave, 2010).
61. For an account of the jurisprudence of Muslim minorities, see Said Fares Hassan, *Fiqh al-Aqallīyāt: History, Development, and Progress* (London: Palgrave, 2013).
62. As-Sayyid Ali al-Hussaini as-Seestani, *A Code of Practice for Muslims in the West* (London: Imam Ali Foundation, 1999).
63. Hassan, *Fiqh al-Aqallīyāt*, 82.
64. http://www.alarabiya.net/articles/2005/04/14/12186.html. I would like to acknowledge that this example was suggested to me by my colleague Dr. Nehad Khanfar.
65. Morteza Motahari, *Dah Goftar* (*Ten Lectures*) (Tehran: Sadra Publications, 1983), 122.
66. See, http://www.jameehmodarresin.org/index.php?option=com_content&task=view&id=325&Itemid=39; http://www.bayynat.org.lb/; http://www.english.shirazi. ir/.
67. Vincenti, *What Engineers Know*, 220.
68. Mohammad Ismail of the Islamic College brought this issue to my attention and provided me with the example cited in the text.
69. Morteda Motahari, *Khatm-e Nabuvvat* (*The End of Prophecy*) (Tehran: Sadra Publications, 1977).
70. http://1saanei.org/?view=02,00,00,00,0.
71. See Ali Paya, "Recent Developments in Shi'i Thought," in *Islamic Democratic Discourse: Theory, Debates, and Philosophical Perspectives*, ed. M. A. Muqtedar Khan (New York and Oxford: Lexington Books, 2006), 123-48.
72. I do not mean that ONLY the *fuqahā'* and engineers rely on inductive mode of inference and induction; many scientists and non-scientists (e.g., philosophers, theologians, ordinary people) also use this mode. But the point is that they are all mistaken. Induction, as Karl Popper (*The Logic of Scientific Discovery*, 1959/2002 and *Conjectures and Refutations*, 1963/2002) and David Miller (*Out of Error*, 2006) have argued, is neither valid as a mode of inference nor possible as a method for discovery. The validity of the inductive mode of reasoning hinges on the validity of the so-called "principle" of the "uniformity of nature." But this "principle" has been arrived at by induction from observed phenomena! In addition, induction cannot be used as a method for developing a "hypothesis" for our observations of facts, for it is based on the assumption that such observations must be done while the observer is completely free from all prejudices,

foreknowledge, prior expectations, and so on. But modern epistemologists have shown that "all observations are theory/hypothesis-laden" and, therefore, it is not possible to observe/collect facts in the absence of prior guiding theories/ hypotheses. I also do not mean that the *fuqahā'* and engineers ONLY use the inductive mode of inference. Of course they also use the deductive mode. In fact, they actually use both modes of inference in tandem. As an example of their reliance on inductive thinking, one can cite the rule of *istiṣḥāb*, according to which the *faqīh* extends his past certainty with regard to something to his present attitude toward it and thus dispels his present doubt about it. In other words, the *faqīh*'s reasoning is based on the assumption that if something had a certain status in the past, then it should be regarded as preserving that status in the present, even if the *faqīh* currently has doubts about it.

73. Miller, *Out of Error*, 2006.
74. This point was brought to my attention by Yaser Mirdamadi.
75. Ludwig Wittgenstein, *Philosophical Investigations* (Oxford: Wiley-Blackwell, 2009).