

The Historical Mandate for the Open-Source Community

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Introduction

Most think of the Open Source Community (OSC) as a venue to get free stuff, but a deep understanding is to know its attitude, its ethics, its purpose, and its sharp teeth. The OSC was born out of the hacker ethic which holds that the unfettered access to knowledge is a virtue of a good and free society. The modern hacker community grew from the playful and clever, sometimes irreverent, pranksters of “the Old MIT” going back to the ’60s and ’70s. For these young pioneers the information world was their playground, a place which was unnoticed by most, feared by those who took note, and misunderstood by nearly all. In 1984, US Congress passed the Computer Fraud and Abuse Act because a Mathew Broderick film scared them - War Games [1] [2] [3] [4]. As industry and regulation began to encroach on their playground, the hacker community began to push back.

Richard Stallman stated that, “A hacker is someone who enjoys playful cleverness, not necessarily with computers. The programmers in the old MIT free software community of the ’60s and ’70s referred to themselves as hackers. Around 1980, journalists who discovered the hacker community mistakenly took the term to mean ‘security breaker’” [5]. In general terms, a hack is an improvised, clever, sometimes brute force, sometimes elegant, solution often designed to overcome or circumvent an obstacle or limitation preventing access to a desired end. A hack may make something perform a task it is capable of but not designed for. A hack often makes something that is inaccessible accessible but is not limited to the realm of “security breaking.” The Open Source spirit at its core is about access and its members’ ability to acquire it.

“Force unregulated or ill-regulated, is not only wasted in the void, like that of gunpowder burned in the open air, and steam unconfined by science; but striking in the dark, and its blows meeting only air, they recoil, and bruise itself... The blind force of the people is a Force that must be economized, and managed, as the blind Force of steam lifting the ponderous iron arms and turning the large wheels is made to bore and rifle the cannon and to weave the most delicate lace. It must be regulated by Intellect. Intellect is to the people and the people’s Force, what the slender needle of the compass is to the ship—its soul, always counselling the huge mass of wood and iron, and always pointing to the north” [6]. These are part of the opening lines to *Morals and Dogma of the Ancient and Accepted Scottish Rite of Freemasonry*. Arguably this political philosophy heavily influenced the founding fathers of the United States of America, but what does it mean to be “regulated by intellect?” [7] Does this mean that the people should be ruled by the few intellectually superior among them or should they be ruled by the intellect within themselves?

History has seen numerous societies with a variety of epistemological approaches to governance through the control and distribution of knowledge. These approaches are evidenced by the attitudes of the political thinkers of the time. Here two attitudes defining the extreme ends of a spectrum emerge. To be sure, this paper focuses on the *attitudes* toward the common person and their ability to conceive knowledge and not the intellectual make up of a population. If we consider attitudes as a spectrum, we define the two extremes. We use this metric to estimate which side of the spectrum, societies of different historical periods fall and to what degree.

The Supercilious Attitude

The *supercilious attitude* is held by those that have a low opinion of the common person. It holds that the common person cannot understand, apply, and/or assimilate modern science, technology, or sociopolitical philosophies. The implications are that the common person cannot properly perceive and interpret modern events and circumstances and therefore should not have an equal participation in governance. This attitude holds that:

- The common person cannot assimilate sensational information without fear or being given to wild extrapolations.
- The common person cannot discern fact from fiction.
- The common person can be led astray by philosophy and/or science and technology.
- The common person can be corrupted by corrupt persons for corrupt ends.

The Populist Attitude

The second extreme attitude is the *populist attitude*. The *populist attitude* holds a great confidence in the wisdom, virtues, judgement, and intellect of the common person. This attitude professes that the quality of a society is only as good as its citizens and the only way to advance society is to educate and advance the common person. The *populist attitude* holds that:

- Ignorance is what makes people susceptible to corruption.
- All knowledge should be available to all who seek it.
- People can learn anything.
- When people work together, they can solve any problem and figure out any unknown.

Methodology

This research starts with a simple thesis: when societies believe that knowledge is the right of all people who seek it, societies thrive, and those societies will develop the means to promulgate that knowledge. This work does not claim to identify causation but correlations in attitudes and the ascension/descension of societies. The focus of this work will center around transitional phases between the decline and ascension of historical societies. This paper will survey these thinkers through the lens of attitudes and will be compared to the historical events surrounding them in terms of socio-political and economic characteristics of the society. Finally, modern events will be described in the context of these eras and the argument will be made that the Open Source community is mandated by history.

The Epistemological Approach to Governance Through Knowledge Control

The epistemological approach to governance holds that leaders must be able to use rational processes and be able to discern fact from fiction, and more importantly, respond to information and/or events unemotionally. Here, one may think of a person as a system. The input is knowledge and their perception of it. Inside the person-system his/her interpretation is based on the person's nature and the interaction of knowledge and their personal experiences. The output is the actions, decisions, and ideas formed from his/her interpretation. If it is believed that not all people have the ability to properly interpret information and thereby cannot employ righteous actions, cannot make rational decisions, and cannot form just ideas, then not all people are worthy of ruling. Furthermore, if it is not believed that all people are aware of all the influences that impact their interpretations, they are not capable of mindful action. The implication here is

that not all are worthy of *all* knowledge, because they may misinterpret it and therefore, act in a misguided manner.

Historians does not agree that anything was inscribed over Plato's Academy, but in the fourth Century an unknown scholiast – thought to be Sopatros – in a manuscript annotation of Aelius, Aristides identified an inscription above Plato's Academy Doors that states, "Let no one who is not a geometer enter" [8]. The Apocalypse of the Golden Mean states that besides the geometers who constructed Plato's Academy, their assistants were given the enter pass "Eis-Phrew", meaning free to enter, which conferred upon them the title "Phreo-Mason", or Free Mason [9]. Whether these accounts are accurate or not, they illustrate an important point, Plato believed that an understanding geometry and mathematics, at large, was necessary to understand the mysteries of the universe as well as necessary preparation for the service of state.

Professor of philosophy at All Hallows College, Edinburg University, Patrick Quinn, in his paper "Knowledge, Power, and Control: Some Issues in Epistemology", outlines the Platonian origins of regulating knowledge for the purposes of governance and "demonstrates some of the classic concerns about the management of knowledge" [10]. Platonic-Socrates' assertion that most people are not worthy of knowledge can be quite dramatic:

"And once a thing is put in writing, the composition, whatever it may be, drifts all over the place, getting not only in the hands of those who understand it, but equally of those who have no business with it. It doesn't know how to address the right people and not address the wrong."
Platonic Socrates in Phaedrus 257e

Platonic-Socrates indicates that there are people who should not have access to certain knowledge. Plato's assertions, however, were based partly on the fact that he did not believe the written word was capable of transmitting truth by its own right but require a person who is capable of discovering truth through self-validating knowledge [10].

"I certainly have composed no work in regard to it nor shall I ever do so in future, for there is no way of putting it in words like other studies. Acquaintance with it must come rather after a long period of attendance on instruction in the subject itself and of close companionship, when suddenly, like a blaze kindled by a leaping spark, it is generated in the soul and becomes self-sustaining." Plato Letter VII, 341cd

Plato did, however, specifically warn that knowledge/truth could corrupt or mislead the common person to disastrous results and stated that a small elite group of people with special intellectual abilities are the only ones that should be trusted with knowledge.

"I do not, however, think the attempt to tell mankind of these matters a good thing except in the case of some few who are capable of discovering the truth for themselves with a little guidance. In the case of the rest to do so would excite in some in a thoroughly offensive fashion, in others certain lofty and vain hopes as if they had acquired some awesome lore." Plato Letter VII, 341d-342a

Plato's assertions here reflect the *supercilious attitude* as he seems to indicate that "the common person cannot assimilate sensational information without fear or being given to wild extrapolations." Quinn references these and other quotes saying:

“These sentiments, which read rather like the account of the prisoner’s journey towards enlightenment in *The Republic*, once again confirm the importance of a self-authenticating form of intuition in Platonic thought and the need to exclude certain people from philosophy for fear of misrepresentation.” [10]

Aristotle believed that it was the duty of rulers to ensure all “citizens” (not slaves and women) are educated. “[T]he legislator must, therefore, make the education of the young his object above all would be disputed by no one” (1337a10). However, Aristotle’s definition of the citizens and those worthy of knowledge was limited at best. Aristotle defined a group he called “the Vulgar:” “[I]t is impossible to pursue the things of virtue when one lives the life of a vulgar person or a laborer” (1278a20). Aristotle seemed to believe that laborers and artisans were not worthy of higher knowledge and the knowledge of the laborer would even corrupt the virtuous:

“There can be no doubt that children should be taught those useful things which are really necessary, but not all useful things; for occupations are divided into liberal and illiberal; and to young children should be imparted only such kinds of knowledge as will be useful to them without vulgarizing them. And any occupation, art, or science, which makes the body or soul or mind of the freeman less fit for the practice or exercise of virtue, is vulgar; wherefore we call those arts vulgar which tend to deform the body, and likewise all paid employments, for they absorb and degrade the mind” (Aristotle, *Politics*, Book VIII, Part 3).

Aristotle not only states that the vulgar should not be citizens and therefore should not be educated, but also asserts that vulgar knowledge should be kept from the citizen for fear of corrupting them. He seems to indicate that anyone who works does not have the time to study philosophy and pursue a virtuous nature and that the very nature of their craft compels a mental focus on lower ideals. This leaves only slave owners and/or business owners who are wealthy enough to spend their days in the plaza contemplating loftier ideals worthy of education and the resultant participation in governance. Aristotle leaves the option for “freeman” to pursue vulgar-esque activities as hobbies but warns that being too skilled or performing such a hobby for others would lower one’s status in society.

“There are also some liberal arts quite proper for a freeman to acquire, but only in a certain degree, and if he attends to them too closely, in order to attain perfection in them, the same evil effects will follow. The object also which a man sets before him makes a great difference; if he does or learns anything for his own sake or for the sake of his friends, or with a view to excellence the action will not appear illiberal; but if done for the sake of others, the very same action will be thought menial and servile. The received subjects of instruction, as I have already remarked, are partly of a liberal and partly of an illiberal character” (Aristotle, *Politics*, Book VIII, Part 3).

Plato held out the possibility that women could participate in the aristocracy, or the group of people worthy of knowledge and rule, but Aristotle did not.

"[T]he male, unless constituted in some respect contrary to nature, is by nature more expert at leading than the female, and the elder and complete than the younger and incomplete" (1259a41).

"[T]he relation of male to female is by nature a relation of superior to inferior and ruler to ruled" (1245b12).

"The slave is wholly lacking the deliberative element; the female has it but it lacks authority; the child has it but it is incomplete" (1260a11).

The Platonian and Aristotelian traditions break societies down into groups and specifically prescribes what knowledge they should have access to. Both indicate that there exists a small specially gifted group worthy of knowledge and capable of virtue with the remaining wholly destitute of the mental capacity necessary to avoid being excited “in a thoroughly offensive fashion,” gaining “lofty and vain hopes as if [one] had acquired some awesome lore,” or suffer some “evil effects.” Plato and Aristotle wrote at length about who should rule (Plato: *Philosopher King*; Aristotle: *Spoudaios*). For them society was to be led by the few with superior virtue, attained through a special intellect that was not accessible to all.

The Attitude of Decline and the Attitude of Ascension

The attitudes surrounding the transitional period between the end of the dark age and the beginning of the Renaissance is of key importance to the thesis of this work. It marks rock bottom for European society and the beginning of the greatest sustained period of technological growth (C14th-C17th Renaissance, C18th-C19th Industrial Revolution). Joel Mokyr makes an argument in his book, *A Culture of Growth: The Origins of Modern Economy* [11], that it is the change in ideas, beliefs and values that led to industrial revolution. The Renaissance culture (values, beliefs and preferences) played a vital role in transforming society.

“But why and how are these people persuaded by new information, ideas, beliefs and values? During the 1500-1700 innovations of many kinds were made. Some of them concerned new information about physical environment or new mathematical concepts and techniques, some contained new religious or philosophical ideas, still others considered what a ‘good society’ should be like. If there were deemed sufficiently attractive (meaning that they represented an improvement in some environments), they were “fit” in an evolutionary sense and spread through persuasion in a choice-based cultural evolution among individuals” p.44 [11].

Mokyr’s assertion indicates that the availability of knowledge and ideas was the key factor in the development and growth of the Industrial Revolution and the advancement of STEM (Science, Technology, Engineering, and Math). Therefore, a change in attitude of the common person in the transitional period between the Dark Age and the Renaissance is of key importance in understanding how and why human societies ascend from darkness.

During the period between the seventh and thirteenth century, while Europe descended into the Dark Age, the Islamic civilization rose to claim its Golden age. “During that time the culture evolved from largely oral to scribal –a momentous change. Writing came to play a crucial and pervasive role in virtually every aspect of life” [12]. In *Paper Before Print*, Bloom quotes Alfred von Kremer, “The Arabs made learning accessible to all. It ceased to be the privilege of only one class, initiating that blossoming of mental activity that burst the chains of fanaticism, superstition and despotism” [13]. But why did the Islamic civilization decline? Mokyr states:

“...the Islamic philosopher Al Ghazali (1058-1111), a Persian whose influence on thought in the Muslim world led to a rising mysticism and occasionalist thinking. He was a key figure in the decline in Islamic Science, which had flourished in the first centuries of Islam. In the views of some historians of science it was due to his influence and that of his followers that the ‘Arabs’ never became ‘a nation of Galileos, Keplers, and Newtons’ (quoted in Cohen, 1994, p.395) [14]. Cohen (2012, p.66) [15] argues that this outcome was far from the author’s original intentions, but the very nature of cultural entrepreneurship means that the forces set in motion often exceed what was originally intended” p.66 [11].

Mokyr's and Cohen's assertions seem to indicate that cultural attitudes can not only lift society but can also send it into decline. This observation is not to ignore the fact that the Islamic Empire suffered several major Mongol invasions including the destruction of Bagdad by Hulagu Khan in 1258, but many historians point to a declining Islamic society going back to the 11th and 12th century [16].

The Platonic-Aristotelian tradition established an in-group / out-group dynamic within society. The in-group were those with the time and intellectual capability to pursue virtue, while the out-group was those who, because of the demands of their profession or station in life, were relegated to a daily struggle for survival. Reminiscent of Maslow's Hierarchy of Needs, the aristocracy spent their days pursuing self-actualization while the "vulgar" spent their days pursuing the means to provide basic needs, such as food and shelter. This attitude continued well into the Dark Age, in the political and philosophical thinkers of the time. The Dark Age was marked by a demographic, cultural, and economic deterioration in Western Europe following the decline of Rome [17]. The Dark Age ended abruptly with the emergence of the Renaissance in the 14th century. The time period surrounding the 14th century marks a dramatic shift from a declining society marked by the loss of technology, knowledge, and culture to an ascending society reborn in rediscovery of lost knowledge and technology, and the innovation of new.

At the end of the Dark Age, information regulation was undeniable but its reasons plural. The Bible and the Liturgy –the source of divine revelation– had never been translated into the common tongue. Many books and publications were restricted –for being taboo or corrupting–, but it may not be the result of power/knowledge mongers; at least not wholly. Books of the time were hand written and paper was expensive. Books were seen as rare, precious, and in need of safe guarding. Dark Age society was surrounded by the ruins of great civilizations. The acquisition of knowledge was seen as rediscovering the science and truths of the past versus discovering new characteristics of our universe [18]. At the end of the Dark Age, the human condition was desperate, a helpless population ravaged by plague, and oppressed by a feudal system –a mass of serfs ready to revolt and ascend in society.

Many prominent thinkers at the end of the Dark Age tended to follow the Aristotelian traditions. Thomas Aquinas (1225-1274), Moses ben Maimonides (1135-1204), and Averroes –Ibn Rushd- (1126-1198) all followed an Aristotelian tradition in their writings, perpetuating the *supercilious attitude*. These thinkers believed that the common person was incapable of learning or discerning fact from fiction without the assistance of an intellectually superior individual to teach them or dumb-down the material through parables or simplified rules. Patrick Quin describes Aquinas' Super de Trin.2.4 "that theological truth is best transmitted to the faithful in parabolic form... it might, he thinks, confuse the uneducated who would misunderstand it and be ridiculed by unbelievers who detest it anyway" [10]. Aquinas states:

"...it is said in Luke 8:10, 'To you it is given to know the mystery of the kingdom of God, but to the rest in parables.' Therefore one ought by obscurity in speech conceal the sacred truths from the multitude" (Pars 1 q. 2 a. 4 s. c. 3).

"...the words of a teacher ought to be so moderated that they result to the profit and not to the detriment of the one hearing him. Now, there are certain things which on being heard harm no one... But there are others which, if openly presented, cause harm in those hearing them; and this

can occur for two reasons: in one way, if the secret truths of faith are revealed to infidels who oppose the faith and so come to be derided by them... Secondly, if any subtleties are proposed to uncultivated people, these folk may find in the imperfect comprehension of them matter for error" (Pars 1 q. 2 a. 4 co. 1)

"but a distinction can be made as regards speaking, since these same truths may be privately revealed to the wise, though publicly silence is kept regarding them." (Pars 1 q. 2 a. 4 co. 2) [19]

Aquinas' statement that some may "find in the imperfect comprehension of them matter for error," implies that if someone does not interpret the scriptures in a manner consistent with the teachings of the church, they should not be allowed to read them. Certainly, the later reformer Martin Luther would take issue with this implication. Aquinas cites 1 Cor. 3:1: "And I, brethren, could not speak to you as unto spiritual, but as unto carnal. As unto little ones in Christ, I gave you milk to drink, not meat." in Pars 1 q. 2 a. 4 co. 1. Aquinas' sentiment about the scripture seems to follow from the writings of Maimonides who pushes this meaning to include understanding of the sciences.

"He, however, who begins with Metaphysics, will not only become confused in matters of religion, but will fall into complete infidelity. I compare such a person to an infant fed with wheaten bread, meat and wine; it will undoubtedly die, not because such food is naturally unfit for the human body, but because of the weakness of the child, who is unable to digest the food, and cannot derive benefit from it. The same is the case with the true principles of science (Ch. XXXIII) [20].

Maimonides seems to follow the Platonic belief that one must understand science in order to understand the mysteries of the universe, and/or some divine truth.

"We must first form a conception of the Existence of the Creator according to our capabilities; that is, we must have a knowledge of Metaphysics. But this discipline can only be approached after the study of Physics; for the science of Physics borders on Metaphysics and must even precede it in the course of our studies, as is clear to all who are familiar with these questions" [20].

Maimonides indicates that the knowledge passed on from God is meant for a more intelligent society than what he observed. This is also evident by his belief that parables were necessary for promulgating divine wisdom.

"[T]he Almighty, desiring to lead us to perfection and to improve our state of society, has revealed to us laws which are to regulate our actions. These laws, however, presuppose an advanced state of intellectual culture" [20].

"If we were to teach in these disciplines, without the use of parables and figures, we should be compelled to resort to expressions both profound and transcendental, and by no means more intelligible than metaphors and similes; as though the wise and learned were drawn into this course by the Divine Will, in the same way as they are compelled to follow the laws of nature in matters relating to the body" [20].

Averroes, an Islamic thinker who lived in the declining Islamic empire, promoted many of the same traditions.

"For the majority cannot read philosophical books only those endowed with superior natures. People are on the whole destitute of learning and are aimless in their reading which they do without a teacher" [21].

In Averroes culture, the works of Aristotle and Plato were not taboo and were available to the common reader, but he warns against reading them if one is not “endowed with a superior nature” or one must have a teacher to guide them toward the real meaning of the text. Averroes is careful not to blame the text, but the lack of guidance for the corruption of a mind.

“From what has been said, it may be taken that a search into the books of the Ancients is enjoined by the Law, when their meaning and purpose be the same as that to which the Law exhorts us. Anyone who prevents a man from pondering over these things, that is, a man... with the merit of learning and disposition - turns away the people from the door by which the Law invites them to enter into the knowledge of God... Such an action is the extreme limit of ignorance and of remoteness from God.

If, by studying these books, a man has been led astray and gone wrong on account of some natural defect, bad training of the mind, inordinate passion, or the want of a teacher who might explain to him the true significance of things, by all or some of these causes, we ought not on this account to prevent one fit to study these things from doing so. For such harm is not innate in man, but is only an accident of training” [21].

If one is not convinced that these thinkers are archaic in their judgement of who is worthy of knowledge and who is corrupted by it and not simply making an observation of their time, these thinkers broadly excluded women from the group of people worthy of knowledge. Aquinas wrote:

“...subjection which is called economic or civil, whereby the superior makes use of his subjects for their own benefit and good... So by such a kind of subjection woman is naturally subject to man, because in man the discretion of reason predominates” [22].

Aquinas’ views prescribe that males have a “nobler action” which requires a separation from females, and he calls this “intellectual operation.” He states that in the animal kingdom males have a nobler purpose than procreation in their life; therefore, they are only united with the female during copulation.

“Among perfect animals the active power of generation belongs to the male sex, and the passive power to the female. And as among animals there is a vital operation nobler than generation, to which their life is principally directed; therefore the male sex is not found in continual union with the female in perfect animals, but only at the time of coition... But man is yet further ordered to a still nobler vital action, and that is intellectual operation” [22].

Aquinas had no excuse for considering women incapable of intellectual operation, because nuns of the time were educated in the same manner as priests and monks. Scholarly nuns were “treated as equals by men of their social class, these women competed successfully with men in classical scholarship, wrote treatises on logic and rhetoric, [and] controlled enormous properties...” [23].

Reminiscent of Aristotle, Maimonides always grouped women with those of the lowest intellectually capabilities.

“These sciences were, therefore, called Mysteries (sodoth), and Secrets of the Law (sitre torah)... This also is the reason why the Torah speaks the language of man... for it is the object of the Torah to serve as a guide for the instruction of the young, of women, and of the common people;

and as all of them are incapable to comprehend the true sense of the words, tradition was considered sufficient to convey all truths which were to be established” [20].

“How, then, could any person speak on these metaphysical themes in the presence of ordinary people, of children, and of women!” [20].

“...these are things which must be explained to every one according to his capacity, and they must be taught by way of tradition to children and women, to the stupid and ignorant” [20].

At the dawn of the Renaissance barely 100 years after the peasant revolt, a new breed of humanist and reformer thinkers were being born who would reverse the opinion of knowledge and the common person. Reformers Thomas More (1478-1535), Martin Luther (1483-1546), Desiderius Erasmus (1466-1536), and Juan Luis Vives (1493-1540) all represented a dramatic shift from the Aristotelian tradition.

Martin Luther (Christian Reformer) believed institutions of learning should be available to all and education should be available to girls as well as boys. He emphasized literacy, if only to read the scripture.

“Above all, the foremost and most general subject of study, both in the higher and the lower schools, should be the Holy Scriptures, and for the young boys the Gospel. And would to God that every town had a girl's school also, in which the girls were taught the Gospel for an hour each day either in German or Latin.” [24].

Luther's attitudes advanced the idea of education for all, but -being a Christian reformer- he was not above restricting knowledge that he felt was harmful.

“[Universities] where very little is taught of the Holy Scriptures of the Christian faith, and the blind heathen teacher, Aristotle, rules even further than Christ? Now, my advice would be that the books of Aristotle, the Physics, the Metaphysics, Of the Soul, Ethics, which have hitherto been considered the best, be altogether abolished” [25].

Juan Luis Vives (Renaissance Humanist) was the first humanist thinker to assert the importance of popular education and touted the positive impact of educating the laity and the poor, on the society at large. Vives wrote, “No greater danger for sons of the poor exists than a cheap, inferior, and demoralizing education” [26]. Vives seems to even tackle the question of how much education should be provided to the less fortunate based on the feasibility of cost to the parent and society at large.

“for when this is done in the case of men-servants and women-servants, and those who place plates and dishes on the table, how absurd it is that it should not be done in the case of those who can only become learned at so much greater cost both to themselves and others. In determining the instruction to be given to each person, the disposition is to be regarded” [27].

Vives does not simply expound idealism but makes a pragmatic attempt to consider a realistic strategy for implementing a publicly available education system; however, he does not indicate that economic disposition is the only consideration. Vives remarks that “psychological inquiry” should be used to determine a student's mental acuity which should also be considered in the student's education.

Thomas More (Renaissance Humanist) educated his daughters in the same manner as his sons, and in his novel, *Utopia* men and women were educated alike. Women were even trained in military skills so that they might take part in war if necessary [28]. More takes the implications of the failures of education further.

“For if you suffer your people to be ill educated, and their manners to be corrupted from their infancy, and then punish them for those crimes to which their first education disposed them, what else is to be concluded from this, but that you first make thieves and then punish them?” [28]

In an unsourced quote Erasmus (Renaissance Humanist) states that “Education is of far greater importance than heredity in forming character.” Erasmus follows suit with More touting the importance of education in society to prevent criminality.

“Being occupied with his studies, a child will avoid the common pitfalls of youth -for learning is something that engages the entire person- and this is a blessing which should not be undervalued” (CWE 26: 297) [29].

Thinkers at the dawn of the Renaissance were less concerned about the corruption of the individual as they were about the social harm that was done by restricting education, and the potential for societal degradation and/or exploitation when knowledge and education is prattle of nobility or a small exclusive group of institutional personalities. These thinkers demonstrate the *populist attitude* in that ignorance is what makes people susceptible to corruption (or criminality) and therefore, knowledge and education should be available to all who seek it. They reestablish a respect and confidence in the common person’s ability to learn.

In the Renaissance, like in the Golden Age of Islam, Western Europe began to enjoy the fruits of literacy and education. Jonathan Bloom says of the Islamic Society’s rise, “Although all sorts of reasons have been adduced to explain the change, I believe that the increased availability and use of paper served as a catalyst” [12]. Similarly, in the Renaissance, cheap paper became available. Charles Van Doren wrote:

“Survivors of the plague did not only inherit money, lands, and buildings. They also inherited clothes, bed furnishings, and other articles made of cloth... hundreds of millions of garments were suddenly useless. Toward the end of the 14th century a new use was discovered for all these discarded articles: manufacturing rag paper... by 1450 there was a large surplus of it, and its price had fallen to a low level”

However, before discarding the role of popular attitudes, consider the role of technology in a different light. Mark Kurlansky in his book *Paper* outlines what he calls the technology fallacy:

“technology fallacy: the idea that technology changes society. It is exactly the reverse. Society develops technology to address the changes that are taking place within it... Chroniclers of the role of paper in history are given to extravagant pronouncements: Architecture would not have been possible without paper. Without paper, there would have been no Renaissance. If there had been no paper, the industrial revolution would not have been possible. None of these Statements are true. These developments came about because society had come to a point where they were needed. This is true of all technology, but in the case of paper it is particularly clear” [30].

Kurlansky uses the example of the invention of the paint brush by Meng Tian in 250 BCE. He states the invention did not inspire people to write, paint, or develop calligraphy; the inspiration was already there and these practices pervasive. However, a stick dipped in ink was hardly an optimal tool, Meng simply invented a better tool to meet the demand and quality the zeitgeist mandated. Perhaps the development of certain technologies is the hallmark of shifting attitudes. The current work has hardly done its due diligence in cause and effect analysis and instead focused solely on correlation. In the example of the Dark Age and the Golden Age of Islam, it can be said that the attitude, that all are worthy of knowledge, correlated to an of ascension for one society, while the attitude that the common person was not worthy of knowledge correlated to the decline of the other. Finally, a shift in attitudes in Western Europe correlates to a rebirth and ascension.

Modern Times

The modern socio-political sphere cannot be said to be purely of a supercilious or a populist attitude. However, due to the diversity of philosophies and ideas, and the global nature of modern societies, extreme examples of these attitudes persist. The Aristotelian concept of the in-group / out-group is still alive and well in political arenas. It is not necessary to debate this at length, because the recent Russian influence operations have demonstrated the in-group / out-group nature of American politics in dramatic fashion.

An analytic report produced by New Knowledge titled “The Tactics & Tropes of the Internet Research Agency” [31] describes the methodological approach used by the Russian run Internet Research Agency (IRA):

“The divisive propaganda Russia used to influence American thought and steer conversations for over three years wasn’t always objectively false. The content designed to reinforce in-group dynamics would likely have offended outsiders who saw it, but the vast majority wasn’t hate speech. Much of it wasn’t even particularly objectionable. But it was absolutely intended to reinforce tribalism, to polarize and divide... blur the lines between reality and fiction, erode our trust in media entities and the information environment, in government, in each other, and in democracy itself. This campaign pursued all of those objectives with innovative skill, scope, and precision.” [31]

In the wake of the revelations of Russian influence operations the US Congress began threatening regulations against social media companies. House Commerce Committee Chairman Greg Walden (R., Ore) described an April 2018 hearing as “a wake-up call for Silicon Valley and the tech community that if you let these things get out of hand, having grown up in a very lightly regulated environment, you could end up with a lot more regulation than you seek” [32]. Facebook CEO Mark Zuckerberg’s opening comments to congress were telling as well,

“it’s clear now that we didn’t do enough to prevent these tools from being used for harm as well. That goes for fake news, foreign interference in elections, and hate speech... It’s not enough to just connect people, we have to make sure those connections are positive. It’s not enough to just give people a voice, we have to make sure people aren’t using it to hurt people or spread misinformation.” [33]

Senator Dianne Feinstein remarked at these hearings:

“We have seen how foreign actors are abusing social media platforms, like Facebook, to interfere in elections and taking millions of Americans’ personal information without their knowledge to manipulate public opinion and target individual voters... It is important that [Mark Zuckerberg] take the initiative and outline specific steps his company will take to regulate and control its platforms so that this cannot happen again. Hopefully private industry will reform and monitor its practices to prevent manipulation of elections and violations of individual privacy. But if they won’t, Congress will have to do it for them” [34].

It cannot be overstated that Facebook and other social media platforms are “media” or individuals a “medium” in the same way paper is medium. The New Knowledge report cites many cases of “inauthentic amplification of otherwise legitimate American narratives” [31] including that of “Conspiratorial Narratives.” One might imagine a Russian internet troll remarking to a friend, “We couldn’t make this stuff up!” Claiming a need to regulate these media outlets indicates that the common person cannot assimilate sensational information (conspiratorial narratives) without fear or being given to wild extrapolations; the common person cannot discern fact from fiction (fake news); the common person can be corrupted by corrupt persons for corrupt ends. Regardless as to whether concerns over the intellect of the common person are merited, this is a *supercilious attitude*.

In the modern times, it could be argued that the biggest obstacle to knowledge is the prohibitive cost of higher education. To complicate the issue, grade schools are not made equal. There is a growing number of notables that encourage young people to forgo college education. Self-made millionaire, James Altucher proclaimed in a podcast, “We’re in an idea-based economy and a skill-based economy, not a certificate-based economy... We used to be in a certificate-based economy. It’s just not true anymore” [35]. Elon Musk once said, “formal education and learning from school are like downloading data into your brain, which can be bad because you are not sure what you have downloaded are going to be useful to you” [36]. Jim Rohn stated, “Formal education will make you a living; self-education will make you a fortune” [36]. Seth Godin, marketing expert and best-selling author, stated “[the] school system trains more followers than leaders” [36]. The list of self-made billionaires who dropped out of college or never went is quite lengthy and includes names like, David Geffen, Micky Arison, Les Wexner, Steve Jobs, Mark Zuckerberg, Haim Sadan, and David Green [37].

Although the evidence that a small percentage of extraordinary individuals were successful, despite the lack of a college degree, hardly decries the institution of higher learning; however, it is clear evidence it is not a necessity for success. It also gives hope to those who find it cost-prohibitive or those with certain learning disfunctions that success is not out of reach. Furthermore, many large companies such as Google do not even ask if an applicant has a college degree anymore [35]. Self-learning is the new resume builder. Access to knowledge and know-how is important for such individual. While colleges and universities struggle to develop “competency-based” educations, the internet is answering the call at an astounding rate. Altucher argued that “young people should focus on getting skills... which you can learn online, by going to the library and reading books or simply once you enter the workforce” [35].

Another significant obstacle to the development and distribution of technology is the patent system. The argument for the patent system is that an inventor needs protection from infringers and to successfully solicit investments (See Open Source Community Section). Abuses of the patent office are well documented; a simple web search and five minutes is all it takes to find a

plethora of articles and websites dedicated to patent abuse [38] [39] [40] [41] [42] [43]. If one does not agree that the patent system, and its patent trial appeal board, over time has come to favor the individuals and companies with large disposable resources, then it is hardly worth the paper to enter into an argument here. This subject will be discussed further in the Open Source Community Section of this work.

Examples of *populist attitudes* are not difficult to find in our modern world. Programs focused on promoting Science Technology Engineering and Math (STEM) to young people such as For Inspiration and Recognition of Science and Technology (FIRST), Association of Computing Machinery (ACM), and GUBotDev are plentiful. Organizations designed to reach underrepresented populations grow in number daily such as National Action Council For Minorities In Engineering (NACME) and TechHive. Some of the organizations that aim to foster interest in STEM among young girls and women by helping them build a strong network and ensuring that they have access to enhance their STEM education and interest include National Girls Collaborative Project, Girls in Tech, Association for women in science and Society of Women Engineering (SWE). There are so many examples of the *populist attitude* in the modern world that extensive justification is not needed. It shows that society not only wants its young people to learn this knowledge, but it needs them to, in order to sustain and progress the human condition.

The Open Source Community

The Open Source Community (OSC) may at first seem like a Marxist organization demanding the distribution of knowledge and intellectual property. However, the opposite is true. It puts forth a radical free-market ethos, in that it asserts the protections afforded to large multi-million-dollar companies should be removed. The practice of patent trolls have demonstrated how blatantly and aggressively the patent office can be abused [39] [40] [41] [42] [43]. Patents can also be appealed using the Patent Trial and Appeal Board. [So, if a struggling entrepreneur sinks her life savings into a great new product she invented, a large multi-million-dollar company can come along and claim the patent should not have been awarded and the patent office can rescind the patent.] The entrepreneur would then lose her life savings and be pushed out of the market presumably because the patent office made a mistake in awarding the patent in the first place. Defending oneself against a patent appeal is likely cost-prohibitive for the struggling entrepreneur, which would encourage her to give up or sell the patent to the suing company. Large companies, however, have the resources to defend themselves against such an appeal. This does not even mention the high cost of acquiring the patent in the first place.

The argument for the patent system is that an inventor needs protection from others who would steal their ideas. Furthermore, the development and delivery of products to the market of new has traditionally required large investments that can only be successfully solicited with the protection of proprietary licenses. But what if our society developed cheaper and easier ways to deliver technology to consumers that did not require large investments? Technology has definitely crested that horizon. To name one solution, rapid prototyping technology, such as 3D printers, and hobby CNCs, provide the ability to deliver physical parts in electronic form.

It may seem that the OSC is a rebellious group of ruffians set on tearing down the old system, abolishing the patent office, attacking big business and reshaping society in its own image; however, this is not the case. The OSC asks no quarter. It does not need congress to act on its behalf. The OSC does not need a different set of rules, it just builds things and spreads its knowledge.

The OSC movement has deep roots going back to the 1970s, in the wake of the civil rights movement. Many of the philosophical roots come from the Hacker Culture of the late 60s and 70s. As enumerated by Steven Levy in his book *Hackers: Heroes of the Computer Revolution*, the hacker ethic has the following tenants [44]:

1. Access to computer or anything about how the world works should be unlimited and total.
2. All information should be free.
3. Hackers should be judged by their hacking, not bogus criteria such as degrees, age, race, or position.
4. You can create beautiful art and beauty on a computer.
5. Computers can change your life for the better.

The OSC was born from people trying to access knowledge and technology that was kept from them. In 1983 Richard Stallman founded the free software foundation [45] launching the GNU project. Stallman and colleagues felt that since they had purchased their computers, they should be able to alter its code. Computer operating systems were unreadable and could not be accessed or modified, so they set out to write their own operating system. Their source code would be available to everyone, for them to review, modify, and redistribute. It would be Linus Torvalds who finally built a stable kernel and incorporated the GNU components to produce the widely used Linux Operating System. In 1998, Netscape released the source code for the Netscape communicator 4.0. Inspired by the Netscape's endeavor, Eric Raymond and Bruce Perens founded the Open Source Initiative [46]. Open Source Software, among other tenants, must be freely distributed with accessible source code; must allow derived works, must not discriminate against persons, groups, or fields of domain; must not restrict other software; and must be technology-neutral [47]. Bruce Perens also launched the open hardware certification program. Open-hardware provides a vector for companies and individuals to produce and distribute physical products with open designs that can be replicated and modified by anyone. The open-source hardware and software company, Arduino, emerged from this open-hardware movement. Arduinos micro-controllers have evolved to play a pivotal role in many modern open-source projects, such as 3D Printers, hobby CNCs, and the flight controllers for Drones.

While the movement is a rebuke of the abusive use of the patent office and intellectual property that the community believes should be in the public domain, it does provide a new vector for companies. LulzBot is an open source 3D printer company that publishes its designs, software, and even a bill of materials and list of its suppliers [48]. Many companies, like FliteTest, have sprouted from popular YouTube channels. While not technically an open-source company, FliteTest developed its customer base by providing free intellectual property – in this case, foam board RC airplane designs – to its followers and provided instruction on how to build them in YouTube videos.

Open-source companies have a few things in common. They tend to hold customer trust as one of their most valuable commodities and they tend to support a large community that rewards them with patronage and assistance in developing their product line. This community has given rise to many collaborative projects that have brought technology to the masses. For instance, the RepRap Project [49], founded by Dr. Adrian Bowyer, created the first low-cost, filament fed 3D Printer bringing rapid prototyping in reach of the common person.

In 2007, Jordi Munoz wrote an Arduino program called ArduCopter designed to stabilize an RC helicopter. In 2009 Munoz, along with Chris Anderson, released ArduPilot 1.0. Ardupilot ran on an Arduino Mega along with a few sensors like a gyro, accelerometer, and barometer. Munoz and Anderson founded 3D Robotics and created the DIY Drones forum which fostered a large community of developers. With the help of their developer community, GPS, and some more open-source hardware and software, ArduPilot was a true autopilot that could control a true autonomous aircraft. Around 2010, an open-source developer known as alexinparis successfully combined a Nintendo Wii control and an Arduino board to create the Multiwii multirotor, flight controller [50]. Alexinparis released the design and software in the open-source community. Today nearly all racing drone flight controllers have evolved from the Multiwii design and software.

The open-source repertoire also includes a collection of open-source software to support its own technological momentum. 3D printers require Computer Aided Design (CAD) programs to design and produce its models. Several open-source CAD programs are available and maintained. To keep up with the OSC, most high-priced CAD programs offer a free version.

Open Source Companies are not only successful, they compete aggressively with proprietary companies. These companies compete because they have an army of open source developers freely contributing to the development of their product line. Proprietary companies can and do rip off their designs, but they cannot keep up with a company that deploys thousands of developers at no cost. They do, however tend to release polished version of open source technology. The OSC does not care that its technology is replicate, modified, and redistributed, because that is what its designed to do; however, when a company proports to be open source and then turns it back on the community, the OSC will not forgive, it will not forget. MakerBot was once a pillar of the open source community, but after Stratasys bought them and they converted to a proprietary company its products were shunned in the community [51]. The OSC does have teeth.

Open source companies prove the prowess of the OSC's attitudes and philosophies and demonstrates the rewards reaped from supporting their customers by providing them with open and free access to their technology. MakerBot also demonstrates that this loyalty is a two-way street. But the open source companies do not encompass the entire OSC. If you are a droner – person who flies and builds quadcopters- you have likely found yourself watching a video or two of a 9-year-old German kid explaining how to solve a problem, you have been struggling with. The OSC's attitude and philosophies can be found in any hobby, practice, or occupation that people tend to be passionate about and tend to build diasporic communities to advance their passion.

The OSC makes heavy use of YouTube for instruction and to build a following. Advertisements and platforms such as Patreon, GoFundMe, and KickStarter provide vectors for OSC contributors to monetize their labors. These platforms represent a new self-reinforcing information dissemination system. These venues are to the OSC what parchment was to the Golden Age and rag paper and movable type was to the Renaissance.

Discussion

The impact of OSC on the engineering industry has already been transformative. However, the implication of this transformation has yet to be fully realized by the larger engineering world. There is already an entire generation of young adults who never went to sleep at night with an unanswered question, due to a large variety of internet connected devices always within an arm's reach. A new generation of young engineers is rising who will never go to bed without the know-how to build whatever creation their curiosity desires, on account of all the tutorials, guides, and videos only a web search away. The engineer of the future is a STEM Ninja who can learn anything overnight. She speaks the languages of all the engineering disciplines. He is building college level projects by the time he is in middle school. She is simultaneously a Software, Mechanical, and Electrical engineer. He solves problems faster, because he has a community of thousands of collaborators to help him develop a solution. The open source engineer is better, because she is a high-speed, low-drag STEM Warrior. If college is too expensive for the engineer of the future, he will learn what he needs to know online and take certification tests to bolster his resume.

Is the open-source community bringing a new age and can it be said to be a relatively better future? High technology is no longer the exclusive domain of multimillion-dollar companies. Many do-it-yourselfers are replicating the high tech projects of big companies, like James Bruton's (XRobots) OpenDog [52] based on the Boston Dynamics Big Dog Robot [53]. Nowadays, hacking is becoming the new second amendment: it's a skill you can legally acquire; governments are afraid of it; everyone fears it will fall into the wrong hands; and it is seen as a tool for opposing oppressive regimes -as demonstrated in the dramatic fashion during the Arab spring [54] [55] [56] [57]. The OSC is trying to build a future that is not one where the masses rely on the few to provide their technology, but one that is driven forward by the constant innovation coming from every household and every mind. The new rag-paper is YouTube and GitHub. Yet the OSC does have teeth. It was born in a revolution, its mother was a hacker, its father the internet and it has inherited their nature, it does not forgive... it does not forget. The OSC holds that no one knows better how to solve a problem than those who have it. The STEM disciplines and technology provide problem-solving tools and techniques to overcome these obstacles. The open-source community provides access to knowledge and education, flattens steep learning curves, and provides downward pressure on the high cost of technology and education. Whether or not this is a relatively better future, it would seem it is the future, nonetheless.

Conclusion

A critique such as this is difficult given that for centuries intellectuals have knelt at the altar of the revered Aristotelian thinkers, some of which are literally canonized. However, history

presents much evidence that the attitudes toward the common person, their ability to learn and their access to knowledge, correlates to an entire civilization's destiny. Fatalist attitudes that lock humans to their lot in life, such as that of Al Ghazali's occasionalism or Europe's nobility/feudal system, clearly correlate to or even predict decline. Whereas attitudes that the common person is worthy and capable of advanced knowledge normally signal a society in ascent. Therefore, history seems to confer a mandate on those entities that place faith in the common person and disseminate knowledge and know-how to the masses, bestowing on to them the societal tiller that steers the "huge mass of wood and iron, and always pointing to the north" [6].

When societies believe that knowledge is the right of all people who seek it, societies thrive, and those societies will develop the means to promulgate that knowledge. The OSC is built on the founding principle that information and knowledge should be accessible to all. Technology platforms, such as YouTube, GitHub and Stack Overflow –to name a few– have provided the OSC with a power house network to distribute its know-how. We live in a world where the simple act of buying shoes may lead to child labor, global warming, or who knows what other ill effect, everything we do seems to hurt someone, but educating people and sharing knowledge is simply good... no wonder so many people do it.

Works Cited

- [1] "Computer Fraud and Abuse Act," Wikipedia, 17 Feb 2019. [Online]. Available: https://en.wikipedia.org/wiki/Computer_Fraud_and_Abuse_Act. [Accessed 13 Mar 2019].
- [2] "What Is The Computer Fraud and Abuse Act?," CyberSecurityMastersDegree.org, [Online]. Available: <https://www.cybersecuritymastersdegree.org/what-is-the-computer-fraud-and-abuse-act/>. [Accessed 14 Mar 2019].
- [3] R. Wydeven, "'War Games' movie prompted introduction of computer fraud act," Post Crescent, 12 May 2018. [Online]. Available: <https://www.postcrescent.com/story/money/2018/05/12/war-games-prompted-introduction-computer-fraud-and-abuse-act/590388002/>. [Accessed 14 Mar 2019].
- [4] D. McCullagh, "From 'WarGames' to Aaron Swartz: How U.S. anti-hacking law went astray," CNet, 13 Mar 2013. [Online]. Available: <https://www.cnet.com/news/from-wargames-to-aaron-swartz-how-u-s-anti-hacking-law-went-astray/>. [Accessed 13 Mar 2019].
- [5] Wikipedia, "Richard Stallman," Wikimedia, 7 Apr 2019. [Online]. Available: https://en.wikiquote.org/wiki/Richard_Stallman. [Accessed 16 Apr 2019].
- [6] *Morals and Dogma*, Richmond: L.H. Jenkins, 1915.
- [7] L. Project, "Freemason and the Founding Fathers," Lab for the Education and Advancement in Digital Research, Michigan State University, [Online]. Available: <http://projects.leadr.msu.edu/uniontodisunion/exhibits/show/freemasons-and-the-murder-of-w/freemason-and-the-founding-fat>. [Accessed 16 Apr 2019].
- [8] D. Fowler, *The Mathematics of Plato's Academy: A New Reconstruction*, Oxford: Clarendon Press, 1999.
- [9] H. Riscoe, *The Apocalypse of the Golden Mean*, Los Angeles: Alanpuri Trading, 2012.
- [10] P. Quin, "Knowledge, Power and Control: Some Issues in Epistemology," [Online]. Available: <https://www.bu.edu/wcp/Papers/Poli/PoliQuin.htm>. [Accessed 24 September 2018].
- [11] J. Mokyr, *A Culture of Growth: The Origins of Modern Economy*, New Jersey: Princeton University, 2017.
- [12] J. Bloom, "Paper Before Print: The History and Impact of Paper in the Islamic World," New Haven, Yale University Press, 2001, p. 122.
- [13] J. Bloom, "Paper Before Print: The History and Impact of Paper in the Islamic World," New Haven, Yale University Press, 2001, p. 1.
- [14] F. H. Cohen, *The Scientific Revolution: A Historiographical Inquiry*, Chicago: University of Chicago Press, 1994.
- [15] F. H. Cohen, *How Modern Science Came into the World*, Amsterdam: Amsterdam University Press, 2012.

- [16] E. Chaney, "Religion and the Rise and Fall of Islamic Science," May 2016. [Online]. Available: <https://scholar.harvard.edu/files/chaney/files/paper.pdf>. [Accessed 17 Mar 2019].
- [17] "Dark Ages (historiography)," Wikipedia, 15 Mar 2019. [Online]. Available: [https://en.wikipedia.org/wiki/Dark_Ages_\(historiography\)](https://en.wikipedia.org/wiki/Dark_Ages_(historiography)). [Accessed 16 Mar 2019].
- [18] G. C. S. PhD, "Galileo: Science, Faith, and the Catholic Church," Now You Know Media Inc. , Rockville, MD, 2015.
- [19] Aquinas, "Aquinas on Boethius on the Trinity: Question 2," The Logic Museum, 2010. [Online]. Available: <https://www.logicmuseum.com/authors/aquinas/superboethiumq2.htm>. [Accessed 17 Mar 2019].
- [20] M. b. Maimonides, "The Guide for the Perplexed," 1904. [Online]. Available: http://teachittome.com/seforim2/seforim/the_guide_for_the_perplexed.pdf. [Accessed 17 Mar 2019].
- [21] J.-U.-R. Mohammed, *The Philosophies and Theology of Averroes*, Baroda: A. G. Widgery, 1921.
- [22] T. Aquinas, "The Summa Theologica," 1947. [Online]. Available: <https://dhspriority.org/thomas/summa/FP/FP092.html#FPQ92OUTP1>. [Accessed 17 Mar 2019].
- [23] S. Kersey, "Medieval Education of Girls and Women," *Educational Horizons*, vol. 58, no. 4, pp. 188-192, 1980.
- [24] M. Luther, "An Open Letter to The Christian Nobility by Martin Luther (1483-1546)," [Online]. Available: <http://www.iclnet.org/pub/resources/text/wittenberg/luther/web/nblty-07.html>. [Accessed 18 Mar 2019].
- [25] M. Luther, "Martin Luther, Address To The Nobility of the German Nation (1520)," [Online]. Available: http://www.sjsu.edu/people/cynthia.rostankowski/courses/HUM1BS17/Lecture_26%20Luther_Lotzer_Calvin.pdf. [Accessed 18 Mar 2019].
- [26] J. L. Vives and A. Tobriner, *On Assitiance to the Poor*, Toronto: University of Toronto Press, 1999.
- [27] J. L. Vives, *Vives: On Education*, London: Cambridge University Press, 1913.
- [28] T. More, *Utopia*, New York: Dover Publications, Inc., 1997.
- [29] E. Rummel, "Desiderius Erasmus," *Standford Encyclopedia of Philosophy*, 27 Sep 2017. [Online]. Available: <https://plato.stanford.edu/entries/erasmus/>. [Accessed 18 Mar 2019].
- [30] M. Kurlansky, *Paper: Paging Through History*, New York: W. W. Norton & Company Inc., 2016.
- [31] Renee DiResta, Dr. Kris Shaffer, Becky Ruppel, David Sullivan, Robert Matney, Ryan Fox, Jonathan Albright, Ben Johnson , "The Tactics & Tropes of the Internet Research Agency,"

- December 2018. [Online]. Available: <https://int.nyt.com/data/documenthelper/533-read-report-internet-research-agency/7871ea6d5b7bedafbf19/optimized/full.pdf#page=1>. [Accessed December 2018].
- [32] J. McKinnon and D. Seetharaman, "Facebook : In Facebook Hearings, Lawmakers Ramp Up Talk of Regulation," MarketSceener, 11 Apr 2018. [Online]. Available: <https://www.marketscreener.com/FACEBOOK-10547141/news/Facebook-In-Facebook-Hearings-Lawmakers-Ramp-Up-Talk-of-Regulation-2nd-Update-26325586/>. [Accessed 18 Mar 2019].
- [33] M. Zuckerberg, "Facebook, Social Media Privacy, and the Use and Abuse of Data," 10 Apr 2018. [Online]. Available: <https://www.judiciary.senate.gov/meetings/facebook-social-media-privacy-and-the-use-and-abuse-of-data>. [Accessed 18 Mar 2019].
- [34] D. Feinstein, "Facebook, Social Media Privacy, and the Use and Abuse of Data," 10 Apr 2018. [Online]. Available: <https://www.judiciary.senate.gov/meetings/facebook-social-media-privacy-and-the-use-and-abuse-of-data>. [Accessed 18 Mar 2019].
- [35] K. Elkins, "Self-made millionaires say you should think twice before going to college," CNBC, 11 Jul 2017. [Online]. Available: <https://www.cnbc.com/2017/07/11/self-made-millionaires-dont-go-to-college.html>. [Accessed 24 Aug 2018].
- [36] "Billionaires Explaining To You Why A College Degree Is Useless," Wisdom Post, [Online]. Available: <http://www.thewisdompost.com/self-improvement/education/billionaires-explaining-to-you-why-a-college-degree-is-useless/1643>. [Accessed 13 Jan 2019].
- [37] C. Isaac, "Forbes 400: The Self-Made Billionaire Entrepreneurs Who Said No To College," Forbes, 23 Sep 2011. [Online]. Available: <https://www.forbes.com/sites/worldviews/2011/09/23/forbes-400-the-self-made-billionaire-entrepreneurs-who-said-no-to-college/#260cf1475fad>. [Accessed 21 Dec 2018].
- [38] "Coalition Against Patent Abuse," CAPA, [Online]. Available: <https://www.capanow.org>. [Accessed 21 Jan 2019].
- [39] B. Cheney, "Measures Needed to Stop 'Patent Troll' Abuse," Huffington Post, 2 May 2014. [Online]. Available: https://www.huffingtonpost.com/bill-cheney/patent-troll-abuse_b_4724533.html. [Accessed 21 Jan 2019].
- [40] P. Hall, "Patent Law Broken, Abused to Stifle Innovation," Wired Magazine, 2008. [Online]. Available: <https://www.wired.com/insights/2013/07/patent-law-broken-abused-to-stifle-innovation/>.
- [41] H. Levenson, "A Case Study of Patent Abuse: Patent Trolls on the Run — The Printing Industry Is Winning," What They Think?, 5 Apr 2017. [Online]. Available: <http://whattheythink.com/articles/84754-case-study-patent-abuse-patent-trolls-run-printing-industry/>. [Accessed 21 Jan 2019].
- [42] J. Oliver, "Patents: Last Week Tonight with John Oliver (HBO)," YouTube, 19 Apr 2015. [Online]. Available: https://www.youtube.com/watch?v=3bxcc3SM_KA. [Accessed 19 Jan 2019].

- [43] A. Meyer, "The Patent Scam Documentary," 2017. [Online]. Available: <https://www.thepatentscam.com/austin-meyer>. [Accessed 21 Jan 2019].
- [44] S. Levy, Hackers: Heros of the Computer Revolution, Sebastopol, CA: O'Reilly Media, Inc., 2010.
- [45] "Free Software Foundation," Free Software Foundation, 2019. [Online]. Available: <https://www.fsf.org>. [Accessed 10 Mar 2019].
- [46] "History of the OSI," Open Source Initiative, [Online]. Available: <https://opensource.org>. [Accessed 20 Aug 2018].
- [47] "The Open Source Definition," Open Source Initiative, 22 Mar 2007. [Online]. Available: <https://opensource.org/osd>. [Accessed 20 Aug 2018].
- [48] LulzBot, "About," Aleph Objects, Inc., [Online]. Available: <https://www.lulzbot.com/about>. [Accessed 20 Aug 2018].
- [49] "RepRap," RepRap, 17 Mar 2019. [Online]. Available: <https://reprap.org/wiki/RepRap>. [Accessed 18 Mar 2019].
- [50] C. Anderson, "A tribute to the hacker origins of MultiWii," DIY Drones, 19 Apr 2015. [Online]. Available: <https://diydrones.com/profiles/blogs/a-tribute-to-the-hacker-origins-of-multiwii>. [Accessed 23 Aug 2018].
- [51] R. Brown, "Pulling back from open source hardware, MakerBot angers some adherents," CNet, 27 Sep 2012. [Online]. Available: <https://www.cnet.com/news/pulling-back-from-open-source-hardware-makerbot-angers-some-adherents/>. [Accessed 27 Sep 2018].
- [52] J. Bruton, "openDog Dog Robot," XRobots, 7 Mar 2019. [Online]. Available: https://www.youtube.com/playlist?list=PLpwJ0q86vov_PkA0bla0eiUTsCAPi_mZf. [Accessed 16 Apr 2019].
- [53] "BigDog," Boston Dynamics, 2019. [Online]. Available: <https://www.bostondynamics.com/bigdog>. [Accessed 16 Apr 2019].
- [54] A. Simone, "Q&A: Meet the hacker that can overthrow a government. Planning a coup? Skip the guns and bombs and hire a team of hackers instead," www.medium.com, 29 Aug 2016. [Online]. Available: <https://medium.com/un-hackable/q-a-meet-the-hacker-that-can-overthrow-a-government-with-just-a-laptop-531a6bcc3b12>. [Accessed 15 Apr 2019].
- [55] Wikipedia, "Operation Tunisia," Wikimedia Foundation Inc., 5 Nov 2018. [Online]. Available: https://en.wikipedia.org/wiki/Operation_Tunisia. [Accessed 15 Apr 2019].
- [56] A. C. Estes, "The Hacks That Mattered in the Year of the Hack," The Atlantic, 28 Dec 2011. [Online]. Available: <https://www.theatlantic.com/technology/archive/2011/12/hacks-mattered-year-hack/333755/>. [Accessed 15 Apr 2019].
- [57] S. Asokan, "The 'hacktivists' of Telecomix lend a hand to the Arab Spring," Washington Post, 6 Dec 2011. [Online]. Available: <https://www.washingtonpost.com/lifestyle/style/the-hacktivists-of-telecomix-lend-a-hand-to-the-arab->

spring/2011/12/05/glQAAosraO_story.html?utm_term=.a688c36fd3e1. [Accessed 15 Apr 2019].