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MANAGEMENT | LETTER

Thriving in a new patent world: Mitigating the unintended consequences of the America Invents Act

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Abstract: Our article epitomizes systems thinking not only to identify possible *unintended consequences* of the Leahy-Smith America Invents Act (AIA), but also to offer suggestions mitigating their impact. Employing two-loop, generic system archetypes, our intent is to help stakeholders in intellectual property (IP) understand some of the nuances influencing the patent lifecycle linked to AIA. Building on the *lingua franca* used in patent law, our article highlights four important changes: being the *first-to-file* for protection; eliminating *best mode* disclosure; expanding the definition of *prior art*; and expanding *post-grant review*. Armed with a better understanding of the system issues imbedded in the legislation, innovators and entrepreneurs can develop strategies to deal with the attendant issues. For example, the *tragedy of the commons* associated with *first-to-file* highlights the need to increase R&D resources; else, over time incremental innovation will inevitably dominate efforts to modify the patent portfolio. Overall, AIA represents a step forward in harmonizing the US with the rest of the world while it increases the transparency of the legal maze that remains patent law; however,

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PUBLIC INTEREST STATEMENT

This article informs the myriad stakeholders who are responsible for protecting intellectual property (IP): innovators, entrepreneurs, scientists, engineers, marketers and attorneys. We clarify four important changes to the US patent system as a consequence of the implementation of the *Leahy-Smith American Invents Act* (AIA): being *first-to-file* for protection; eliminating *best mode* disclosure; a more expansive view of *prior art*; and *post-grant review*. Understanding the implications of these changes will reduce stakeholder missteps that could not only jeopardize patent approval (for example, disclosing an invention publicly before filing a patent application), but also negatively impact the product portfolio of an enterprise, as well as its competitiveness in the market ecosystem. We apply systems thinking and generic archetypes to highlight ways to mitigate key unintended consequences of AIA on IP stakeholders, and highlight possible systemic impacts in economic, social, political, and technological spheres (for example, shifting innovation from breakthrough to incremental improvements).

the changes bring allocation issues, secrecy, and time pressure to the forefront of the conversation about new product development. Recognition of these impacts is relevant worldwide for anyone contemplating a US patent or any entity attempting to maintain a viable portfolio of intellectual property.

Subjects: Technology; Intellectual Property Law; Patents; International Law

Keywords: America Invents Act (AIA); patents; product portfolio; systems; systems thinking; unintended consequences; intellectual property

1. Introduction

We cannot solve our problems with the same thinking we used when we created them. Einstein

Our experience with patents goes back decades. Years ago, we wondered why our product designs were always constrained by certain manufacturing processes: the word circulated within the enterprise that someone in engineering held a patent that forced everyone to stay within a specified “box,” no matter the attempt at innovation. Years later, while advising the entrepreneur heading a biotech start-up, we had to advocate for changing the patent attorney of record because it became apparent that the lack of expertise in the technology hindered the prosecution of the patent that became the foundation of the enterprise: thousands of precious investment dollars fell by the wayside.

Over the last two decades, many have noted the need for innovators and entrepreneurs to develop a more nuanced view of issues related to intellectual property (IP) (Crawford, 2012; Drucker, 1998; Granstrand & Oskarsson, 1994). Too many fail to seek patent protection for innovations, and they publicly disclose new inventions before filing a patent application: resulting in a waiver of their patent rights (noted by R.J. Genet in Crawford, 2012). For engineers, in particular, the need for increased mindfulness is acute (Laney, 2001, p. 4):

... every schematic, each piece of software code, and every drawing, diagram, and prototype has intellectual property rights attached upon creation ... These rights are the legal essence of an engineer’s output, for if an actual disk or prototype is lost, another can always be had. But if the legal rights are lost, the disk or prototype may be worthless—even if securely in hand ... Employers guard the economic value created by the engineering process as carefully as the output of the manufacturing process itself ...

Lin, Chen, and Wu (2006, p. 17) recognize the overall challenge:

The most challenging task of managers in the current knowledge-based economy is to exploit the full value of corporate intellectual properties and to effectively accumulate and commercialize knowledge assets. This challenge is not new for technology managers since their primary job is to manage corporate technological assets and to develop new technological capabilities.

In the US since 2011, this concern is paramount because of the promulgation of the Leahy-Smith America Invents Act (AIA), US policymakers’ attempt to improve the patent lifecycle at the US Patent and Trademark Office (USPTO). AIA focuses on *harmonizing* with other national, patent systems, on improving *efficiency*, and on increasing *transparency*: changing to *first to file*; eliminating *best mode* disclosure; expanding *prior art*; and adding *post-grant review*, among others (Francis, 2012).

Unfortunately, AIA arrives with the same concern surrounding the creation of any new law because lawmakers may be *unaware of, or knowingly screen out complex issues that could affect the outcomes of the laws they are creating* (LoPucki, 1997). Gaining insight into the situation requires interdisciplinary learning: specifically, *perspective taking*, and *thinking more comprehensively* (Mathews & Jones, 2008). *Perspective taking* in interdisciplinary understanding involves *examining a problem from the*

standpoint of interested disciplines ... and identifying the differences (Repko, 2008), and it is essential to understanding how various stakeholders interrelate. *Thinking more comprehensively* incorporates not only how stakeholders identify a problem, but also important causal factors contributing to the problem, as well as the relationships among those factors.

This inherent complexity and likely spate of *unintended consequences* beg for *systems thinking* to uncover inherent problems and suggest solutions. This need is especially acute when law is involved since the structure is massive and few know it well enough to intuit leverage points (Billingham, 2013). Adopting *systems thinking* facilitates a *shift in perspective from law as a conceptual system to law as an element of concrete, empirically-verifiable "law-related" systems ... [and] ... has the potential to put legal scholarship in touch with reality* (LoPucki, 1997).

Our article aims to help innovators and entrepreneurs understand some of the nuances of these dramatic changes to the patent lifecycle. This mindfulness begins with exposure to the *lingua franca* used in patent law. In addition, this article exemplifies *systems thinking*, employing *two-loop, generic archetypes*, to highlight techniques and processes to mitigate possible *unintended consequences* arising from AIA's implementation. Armed with a better understanding of the systems issues imbedded in the changes, IP stakeholders, regardless of discipline or managerial role, will be prepared to make significant contributions to their organization's goal of maintaining a viable IP portfolio.

2. Leahy-Smith America Invents Act

Change is the way of life. John F. Kennedy

AIA changes the IP landscape. It signals the need for a major shift in strategic thinking not only about protecting intellectual property, but also about constraints on new product development. Lerner, Speen, and Leamon (2015) emphasize both the act's complexity, and its ambiguity; they raise concerns about the consequences of the reforms. The uncertainty surrounding the implementation of AIA behooves innovators and entrepreneurs around the world to become familiar with its critical aspects.

Under AIA, worldwide *harmony* is built around the granting of a patent to whoever *files first*, not the *first to invent*. Subject to the payment of fees, patents are typically granted for a term beginning on the date on which the patent issues and ending 20 years from the priority date for the patent (Patents-getting started, 2013). Disregarding nuances, the median time between application and issue (defined as *patent pendency*; Troyer, 2016) continues to decrease, remaining around 3 years; although the range between shortest and longest pendency in 2014 was over a decade (Crawford, 2012). Gaging patent pendency remains complex given that patent examination may be deferred; in the US, a patent applicant may request up to a three-year delay (Suspension of action by the office, 2018). Successfully navigating pendency forces both innovator and entrepreneur to make honest judgments about the value of an innovation, per se, as well as its contribution overall to the technology portfolio of an enterprise.

Finally, another type of *harmony* is guaranteed. Submarine patents (intentionally delaying publication of a patent in order to sue others who may use it in the future) are no longer possible because a patent becomes public knowledge long before it is granted or abandoned: patent applications in the US are published automatically after 18 months (Neustel, 2013).

AIA's elimination of the need to disclose the *best mode* for the innovation also helps *harmonize* the US with the rest of the world. Before AIA, US patent applications had to disclose the *best mode* or risk invalidation. The intent was to ensure that competitors could compete fairly following expiration of a patent by prohibiting the patent owner from withholding crucial details about the most valuable commercial form of the invention (Petherbridge & Rantanen, 2012). After AIA, the requirement, while technically still present, is effectively unenforceable (Auvil, 2011).

AIA expands the definition of *prior art* to include both foreign sales and public uses. With few exceptions, any prior disclosure of an invention is *prior art* and invalidates patentability (Villasenor, 2012). In addition, the actions of third parties unrelated to the inventor can invalidate patentability if they share publicly the particulars of a technology and undermine its claim to novelty. The expanded definition remains ambiguous: what is included in terms of specific protections in the year-long *grace period* provided for inventors to file after a disclosure without endangering a claim of novelty for their invention remains unclear. AIA may, in some cases, limit the reach of prior art.

The added *transparency* embodied in AIA seeks to avoid litigation over patents. *Post-grant review (PGR)* is now an integral part of the patent prosecution process. Sometimes the process can favor someone opposing an existing patent, while at other times the process can favor a patent holder. Regarding the former, an opposing party has nine months in which to ask USPTO to review a patent's validity on any of the usual grounds of patentable subject matter: novelty, utility, obviousness, or failure to provide an adequate written description (enablement). *PGR* requires only the lower *preponderance of the evidence* standard rather than the higher *clear and convincing evidence* standard required in court (Lu, Uthaman, & Kowalski, 2012). Also, patent validity is not assumed under *PGR* as it is in court. Favoring a patent holder, the notion of *deceptive intent* is eliminated; Noonan (2013) notes that an applicant is no longer bound by a "duty of candor" during the prosecution of a patent. Defending against infringement claims is less costly since administrative evaluation is encouraged outside of district court (Lin et al., 2006).

3. Systems thinking about AIA

Everything must be made as simple as possible...But not simpler. Einstein

Given this quick overview of the key changes with AIA, a systems thinker (Meadows, 2008) recognizes not only that the quest for *harmony, efficiency, and transparency* is laudable, but also that the connections among AIA, innovators and entrepreneurs produce a characteristic set of behaviors: some pleasant; some, not. A systems thinker searches for cause and effect relationships among the system elements; observes how elements form a pattern; recognizes how attendant connections generate both *intended consequences* (outcomes) and *unintended consequences*. A systems thinker aims to make organizational boundaries transparent to help stakeholders communicate better (Wolstenholme, 2003) by highlighting the impact of contemplated changes.

Better communication about the implementation of AIA begins by recognizing underestimated dangers. Tenner's (1996) framework identifies five generic types of dangers, manifested as *unintended consequences*. *Recomplicating* consequences happen when a new law makes the environs more complex: everyone involved needs not only vigilance to prevent the situation from becoming overwhelming, but also sophisticated craftsmanship to function in the new atmosphere. *Recongesting* consequences occur when new laws appear to open unlimited vistas but actually clog the byway with competition (as happened with demand for media broadcasting bandwidth): more venues must be opened; more help must be found; and streamlining or compression algorithms must be implemented; else, delay becomes the new watchword for the system. *Repeating* consequences happen when new laws funnel everyone into focusing on the same task, over and over: processes and procedures must be put in place to allocate time for important tasks that otherwise will be neglected in the incessant repetition. *Rearranging* consequences take place when new laws change the focus from one set of tasks to another, to the detriment of the health of the overall system: modified processes and procedures allocate time to avoid neglecting important tasks. *Regenerating* consequences result when new laws cause new problems: new solutions must be implemented, but not necessarily new law (Tenner, 1996).

Systems thinkers facilitate better communication by employing diagrams that emphasize either causal loops or stocks and flows. Causal loop diagrams enable stakeholders to visualize system complexity, and gain insight into how the disciplinary parts of the problem relate to *each other and to the problem as a whole* (Repko, 2008). Once stakeholders understand the dynamics of the

Table 1. Permutations of Balancing and Reinforcing Loops Define Four Generic, Two-loop System Archetypes and Solution Links (Adapted from Wolstenholme, 2003)

		Causal Loop		
		Intended Consequence	Unintended Consequence	Solution Link
Generic, Two-loop System Archetypes	Underachievement	Reinforcing Loop (R)	Balancing Loop (B)	Reinforcing Loop (R)
	Relative Control	Balancing Loop (B)	Balancing Loop (B)	Balancing Loop (B)
	Relative Achievement	Reinforcing Loop (R)	Reinforcing Loop (R)	Balancing Loop (B)
	Out of Control	Balancing Loop (B)	Reinforcing Loop (R)	Balancing Loop (B)

system, they can identify and test hypotheses about where and when to intervene in the system, as well as propose ways to mitigate potential problems. Thus at the outset of the conversation about how to define and structure an issue, causal loop diagrams take center stage; later, when precise quantification of all the system's parts and their interrelation is key, stock-flow diagrams dominate the conversation: especially if the goal is to simulate the behavior of a system over time. Toward the end of the conversation, causal loops again reign, with a focus on synthesizing insights instead of details. Always, the choice between loops and stocks is a compromise between *simpli-city for communication and completeness for validity* (Wolstenholme, 2003).

Since one major goal of this article is to show ways to mitigate possible *unintended conse-quences* arising from AIA's implementation, causal loop diagrams, their *generic, system arche-types*, and their *generic solutions* define the bounds of the article. Thinking about the permutations of a balancing loop and a reinforcing loop defines the minimum number, four, of generic system archetypes possible: *underachievement*; *relative control*; *relative achievement*; and *out of control* (Table 1; Wolstenholme, 2003). Table 2 shows the connection between these two-loop systems and the *classic* set of archetypes differentiated by either growth or fixing problems (Braun, 2002): note the linkages between the two sets. As we will demonstrate, these linkages offer decision makers a robust toolkit for communicating the intended and unintended consequences of a complex system, as well as highlighting means to mitigate undesirable outcomes.

4. Mitigating the unintended consequences of AIA

See the whole; see interrelationships rather than things; see patterns not snapshots. Da Vinci

Our article now moves from general archetypes to their specific application related to AIA. The goal is to help IP stakeholders structure, understand and predict the consequences associated with AIA. Armed with this tool, the conversation also includes a *solution link* to mitigate the unintended, negative impacts. Four key concerns dictate the tone of the conversation. Each assertion follows the simple model proposed by Einstein's hypothesis describing the link between mass and space: *objects with mass cause space to bend*. Our first proposal is that, overall, the innovativeness of individual patents will decrease because of AIA. Second, the desire to disclose *best mode* will decrease because of AIA. Third, the climate of secrecy within and across enterprises and institu-tions will increase because of AIA. Finally, the value proposition of a portfolio of technology-based ideas, goods, and services will become adulterated because of AIA.

Specifically, we develop figures showing how specific combinations of *two loop*, generic systems and classic archetypes communicate the impact of key changes wrought by AIA. Each figure has common elements: some initial, intentional activity by decision maker (a top rectangle) results in both some intended consequence (a middle rectangle), as well as an unintended consequence (a bottom rectangle "outside" a system boundary). Each figure also shows a possible "solution link"

Table 2. Classic Archetypes Map Directly to Generic, Two-loop Archetypes (Adapted from Braun, 2002; Wolstenholme, 2003)

"Classic" Archetypes	Generic, Two-loop System Archetypes			Aspect of America Invents Act		
	Growth and Underachievement	Under achievement				
Limits to Success						
Tragedy of the Commons						
Drifting Goals				First to File		
Escalation		Relative Control			Best Mode	
Success to the Successful		Relative Achievement				Prior Art
Accidental Adversaries		Out of Control				
Fixes that Fail						
Shifting the Burden						Post-Grant Review

(that includes either a balancing or a reinforcing loop, depending upon the archetype involved) that might mitigate the effects of the unintended consequences. Additionally, the right side of each figure pays homage to system dynamics by showing a notional change in relevant activities over time, by plotting an appropriate normalized quantity versus time.

4.1. First-to-file

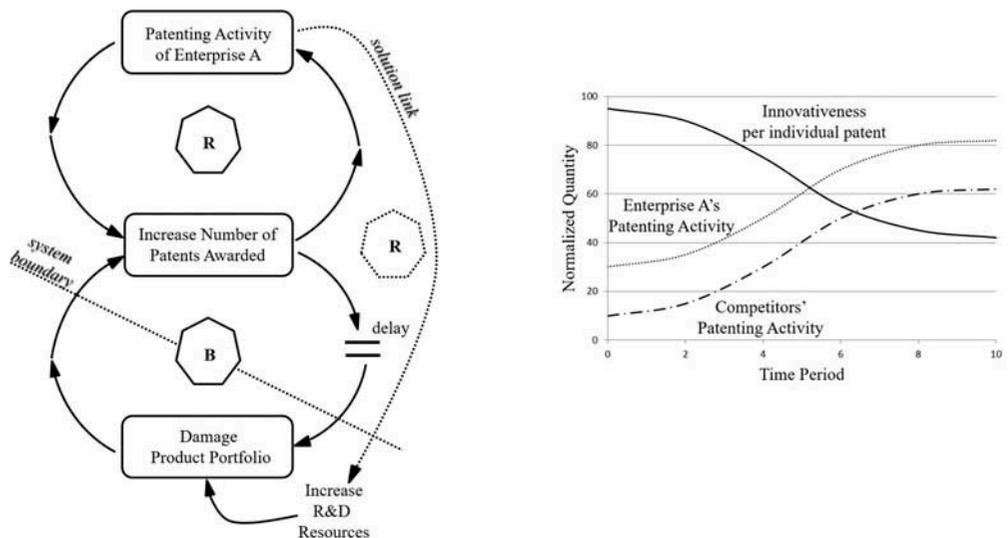
A systems thinker recognizes that the compulsion for worldwide *harmony* has risks. Consider the *unintended consequences of first-to-file*, the most widely discussed feature of AIA (Villasenor, 2012). With AIA a patent is usually awarded to the first entity to file. Before AIA, if a second party filed for a patent for the same invention, expensive, interference proceedings took place to identify the actual first inventor. The search for “first” focused on proof of “first thought” and a working model of the invention, when applicable. Still with AIA, Reiter, Baker, and Fasse (2012) note three exceptions where a second party to file *may* have rights to a patent. Generally, however, the principle is simpler now: the first application retains rights to a patent, regardless of the date of the invention.

The most obvious *unintended consequence of first-to-file* is a *race to the patent office*. This *recongesting consequence* arises from a focus on provisional patents (if for no other reason than to help establish an early filing date): this in turn increases the likelihood of delays in the system (Susie, 2013).

Less obvious, and more important, is a *regenerating consequence*: speedy patenting activity leads to an improper balance in the product portfolio, with a trend away from platform and breakthrough innovations in favor of incremental ones (Wheelwright & Clark, 1992). Look at this possible outcome through the lens of the *underachievement* archetype (Wolstenholme, 2003). Figure 1 highlights this *classic archetype, tragedy of the commons*. As with any two-loop, generic archetype, an action (in this case the patenting activity of Enterprise A) generates an outcome (the intended consequence, an increase in patent awards), accompanied with a reinforcing loop (R) that encourages more patent filings.

Unfortunately, an *unintended consequence* accompanies the emphasis on more patent awards: damage to the product portfolio. Typically, a delay (symbolized by broad dashes (=) interrupting the flow of the balancing loop (B)) exists between the original action and the system’s reaction. Figure 1 also shows a solution link (denoted by a dotted line): in this exemplar, the solution entails an additional reinforcing loop (R) between the action and the resource constraint, *the commons* (available resources, such as personnel or the R&D budget). Notionally, without some type of reinforcing connection between patenting activity and product portfolio, the danger is that the commons will collapse from the

Figure 1. Mitigating risk with First-to-File facilitated by an Underachievement Archetype.



unrealistic demands placed upon resources (Braun, 2002). Here the appropriate reinforcing activity is additional monetary and personnel resources for the *commons*. Simultaneously, patenting activity (at both Enterprise A and its competitors) would increase until a limit is reached in a more distant period.

With little effort, applying Tenner's (1996) typology uncovers other, *unintended consequences* of the change to *first-to-file*. Consider the *recomplicating* consequence on the selection and compatibility of alliance partners. McGill and Santoro (2009) conceptualize a firm's alliance partners as a portfolio related to patent output. Partners can be differentiated along two dimensions: nature of resources (knowledge versus property) and inter-organizational mode (transactional versus relational). Firms with alliances characterized as either *focus* or *hedge* (emphasizing either knowledge and relations or property and transactions) have significantly higher patent output. To the extent that alliance partners are motivated to pursue aggressive *first-to-file* strategies, less valuable patents dominate patent portfolios, with a focus on incremental innovation. To the extent, partners are committed to differing *first-to-file* strategies (filing frequently for only incremental changes versus less frequently but for major or breakthrough changes) numerous dysfunctions may arise between partners, including distrust, disharmony, secretiveness, eroding goals of commitment to the alliance, etc. To help mitigate these possible outcomes, clear procedures and protocols need to be established in advance to clarify and ensure transparency about each partner's intended filing strategy, as well as its objectives for the alliance's patent portfolio.

Collectively, these underestimated dangers of pursuing an aggressive *first-to-file* strategy highlight the need to develop new protocols, involving different stakeholders, to identify and evaluate patentable goods and services as early as possible. Heines (2014) emphasizes that these new protocols must be ... *adapted to protect against or minimize any loss ... under the first-to-file rule ...*

Adopting a systems perspective with an environmental boundary that extends to society as a whole highlights a danger that these new protocols may damage the overall innovation rate in the US. For example, if larger enterprises file early and often, they could make it more difficult for smaller enterprises that lack a dedicated patent team to secure patents. *Special*, even new-genre, enterprises may emerge to patent everything and anything around new technologies; these patent filings will deter an original thinker from developing an idea further because of the fear of unwarranted patent infringement claims. Innovators at smaller enterprises may have less motivation to support breakthrough innovation because decision makers siphon resources from their organization's *commons* (R&D budgets, etc.) and redirect patent applications toward incremental innovations. This, in turn, could cause a smaller enterprise to miss strategic opportunities regarding its innovation portfolio and market development. The cascading impact results in fewer startups, slower job creation, lower gross domestic product, fewer exports, and so on: all arguably undesirable consequences in the broader macro environment.

4.2. Best mode disclosure

The elimination of the need to disclose the *best mode* for the innovation hides underestimated dangers, as well, even though it helps *harmonize* the US with the rest of the world. By using the analogy of a sponge, Petherbridge and Rantanen (2012) note how this missing requirement negatively influences the incentive structure of any patent system:

... the best mode requirement helps define the legally required distance between bubbles of restricted information. Specifically, it encourages a greater distance between bubbles ... to limit the patentability of modest incremental improvements ... which may adversely impact the incentive structure The best mode requirement ... cooperates with nonobviousness ... to protect the public domain.

Presumably, higher levels of *nonobviousness* in an innovation imply a stronger justification for granting a patent. Without the need to report the preferred embodiment of an innovation, incremental improvements are more likely to receive a patent. Thus, innovators will need to police patent applications themselves (with increased vigilance searching for less obvious, but more

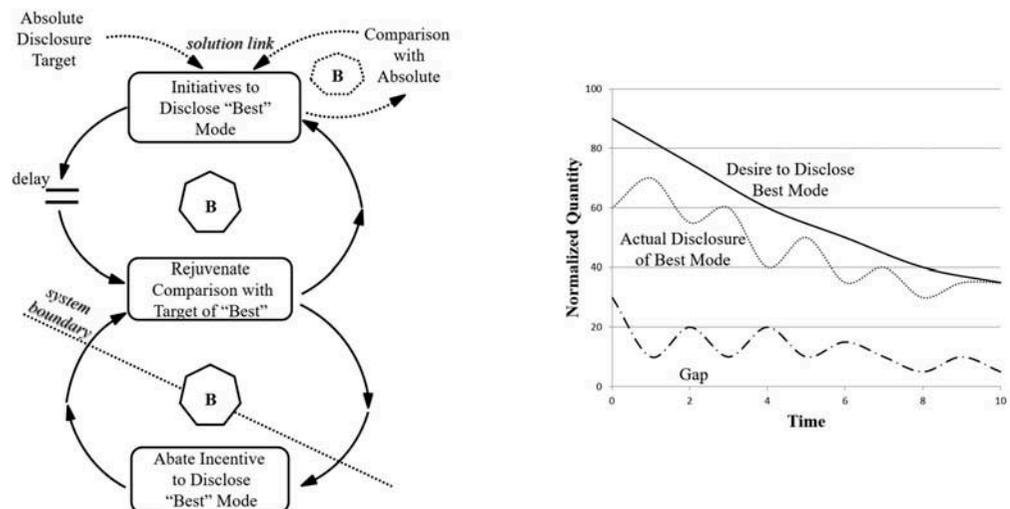
important applications), else their budgets will be consumed by the pursuit of patents with only marginal commercial utility or societal benefit after losing focus on valuable users.

This is a *recomplicating, unintended* consequence, and the classic archetype of *drifting standards* characterizes it with two balancing loops (Figure 2). The key risk uncovered by this *relative control* archetype relates to initiatives to disclose *best mode*. *Best mode* links to *Target of "Best: absolutely the ideal encapsulation of the most commercially viable approach embodying the technology discussed in the patent application*. Now, a disclosure of *best mode* may be other than this ideal encapsulation, reflecting only a *convenient sharing* of one of myriad possibilities. Original goals to provide an ideal, absolute encapsulation sink to lower levels (although the system experiences a delay before this occurs) unless a balancing dynamic is put into play to force a comparison with absolutes.

The notional, dynamic changes in this drifting system showcase two implications, unless decision makers implement a solution link. First, the patent owner's desire to disclose *best mode* diminishes over time. The system reinforces avoiding disclosure (reinforced by legal issues, as well as the pressure of *first-to-file*). The second implication is the ebb and flow of any current practice aimed at disclosing the *best mode* in order to close the gap between what is actually shared and what ideally could be shared (the most commercially viable manifestation of the technology). Some actions may improve actual practices in disclosing *best mode*, but only in the short-term due to the overall pressure to disclose early and expand the IP portfolio.

Without a third balancing loop and its solution link, the long-term impact is that goals are adjusted so they can be met (downward, lowering expectations and performance standards); better solutions aimed at meeting ambitious goals are lost in the process (Braun, 2002). Without the need to report the preferred embodiment of an innovation, a *recongesting, unintended* consequence is possible: applications for patents, especially for marginal improvements, may clog new product development. On the one hand, innovators who wish to disclose the *best mode* (perhaps to gain greater recognition for themselves, department, organization, or to enhance contributions to society) must police applications themselves to make such determinations; else, patents with only marginal commercial utility or societal benefit consume the budget. On the other hand, the change to the *first-to-file* puts pressure on innovators to file early, often before identifying *best mode*. Collectively these possibilities highlight the need to develop new protocols to evaluate the commercial potential of goods and services as early as possible.

Figure 2. Mitigating risk with Best Mode facilitated by a Relative Control Archetype.



4.3. Expansion of prior art

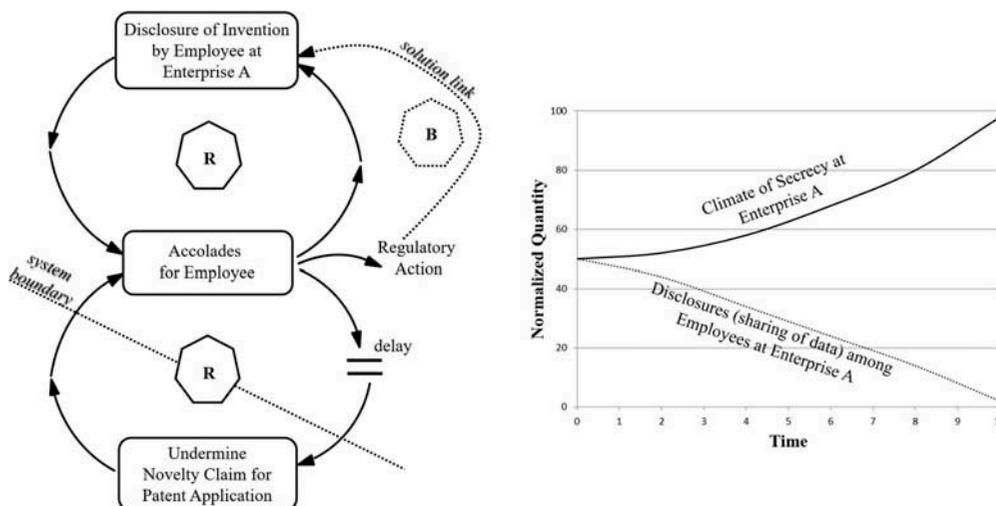
As the compulsion for worldwide *harmony* comes with underestimated dangers, so does the drive for increased *efficiency*. The wording in AIA of “private vs. public sales” is cause for concern for all IP stakeholders. The wording is ambiguous about what is included in the grace period. If, as some have stated ... “available to the public” is read as “on sale”, then private sales and offer-for-sales may no longer be construed as prior art (Raich, 2011). Thus, patent prosecutions may be more difficult, as examiners will have an expanded scope of art to challenge applications. Still, start-ups, smaller enterprises, and individual inventors may benefit from the prior art rules and the one-year grace period. A possible *reverse revenge effect* (Tenner, 1996) of AIA is that start-ups will benefit from a *prior use right’s* defense. To clarify, if an invention is documented and placed into commercial use at least one year before the priority date, commercial use will in all likelihood constitute a defense against infringement (Raich, 2011). The expanded definition of *prior art* means that weighing the pros and cons of almost any disclosure is an absolute necessity: whether it is an offering of the invention for sale to the public or a presentation about the invention by a graduate student (all of this concern leads to a *recomplicating, unintended* consequence).

These changes with regard to *prior art* are embodied in the classic *success to the successful* archetype, a *relative achievement* generic, with the two reinforcing loops shown in Figure 3. In this system, achievement comes at the expense of other stakeholders. The *unintended consequences* of undermining the novelty claim disproportionately outweighs the intended benefit (in this case, accolades for the employee inventor). Even with a delay, the two reinforcing loops form a zero-sum game (Wolstenholme, 2003). Moving to win-win requires an outside intervention (shown via the dotted, third balancing loop between invention disclosure and regulatory action): for example, by developing less stringent disclosure restrictions for academe.

The key danger uncovered by this archetype relates to secrecy. Notional system dynamics in Figure 3 show how the climate of secrecy at an enterprise increases over time. Simultaneously, disclosures among stakeholders decrease. Increased secrecy leads to an increasing number of patents without appeals since minimal doubt exists among possible competitors and patent challengers about prior publication or disclosure. This result reinforces the importance of secrecy: as it receives more attention, collaboration, exchange, and educational efforts receive less. The vicious circle continues with a lasting impact on the innovative climate, especially risk-taking. Secrecy becomes the watchword, repeatedly, in new product development, especially for emerging technologies.

Yet, an enterprise must avoid a blind pursuit of secrecy. Calderini, Franzoni, and Vezzulli (2009) found that with less harsh regimes of secrecy, benefits accrue to all involved because the feedback

Figure 3. Mitigating risk with Prior Art facilitated by a Relative Achievement Archetype.



from applied research is richer: as is likely the case with engineering. They suggest that policies regarding intellectual property rights should be refined and tailored to field specificities. Along similar lines, Cohen, Nelson, and Walsh (2000) found that the protection offered by both secrecy and patents is higher for all chemicals than other products.

Secrecy results in another *unintended* consequence, *recongesting*, that forces entrepreneurs to track what could become ubiquitous non-disclosure agreements clogging the new product development process. Similarly, Thursby, Jensen, and Thursby (2002) found that the incentives set by internal university policies were effective in driving a larger number of disclosures about inventions to local technology transfer offices, producing more patents issued and licensed by universities (Calderini et al., 2009, p. 16). Together, these possibilities highlight the need to develop protocols to handle any disclosures about a possible patentable idea, as well as the scheduling of introductions of innovative goods and services to the market.

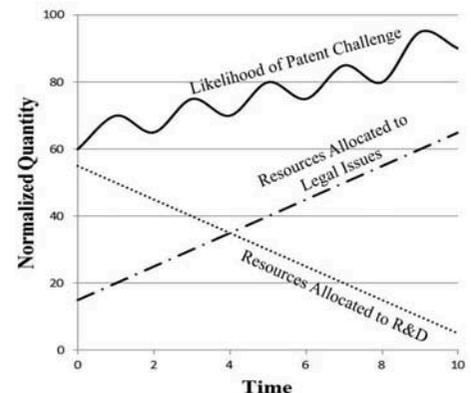
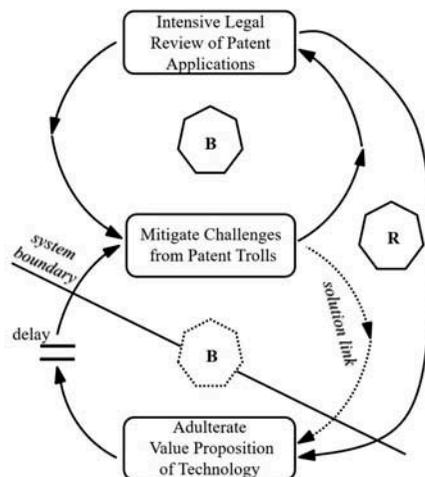
4.4. Post-grant review (PGR)

As a last look at the *unintended* consequences of AIA, consider the added *transparency* aimed at avoiding litigation over patents: *post-grant review*. This change ideally leads to improved cost-effectiveness: allowing a defense against infringement claims by giving anyone a grace period of nine months to review a patent’s validity, without having to go to court and by relying on only the *preponderance of the evidence*. This opens the door for a *reverse revenge* effect (Tenner, 1996): the costs associated with defending a claim through PGR are likely to be substantially lower versus litigation, likely reducing the current practice of settling even non-meritorious claims. On the other hand, with a lowered standard of evidence, more opposition to a patent is to be expected. With respect to the total cost of defending a patent, AIA may be a wash: a patent owner may benefit from the lower per-claim cost of the new administrative procedures, but suffer from an ever-increasing number of claims. Regardless, prudence demands a sinking fund to defend a patent.

This *transparency* (a *rearranging unintended* consequence) is encapsulated in the classic, *shifting the burden* archetype, an *out of control* generic system archetype (recall Table 2), with both a balancing loop and a reinforcing loop.

Figure 4 shows that intensive legal review of a patent application is designed to minimize the challenges from patent trolls. Yet, the reinforcing loop (even more legal review) created by the reaction of others in the enterprise (as a consequence of the control action itself, rather than the outcome, per se), results in the *unintended consequence* of a loss of focus on the value proposition of the technology, the innovation. The solution link introduces a needed second balancing loop to

Figure 4. Mitigating risk with Post-Grant Review facilitated by an Out-of-Control Archetype.



recapture the ideal of providing a compelling value proposition for the technology, and reducing the threat of patent challenges.

The notional system dynamics highlight the danger of moving the focus away from a value proposition to legal nuance. The emphasis on intensive legal review may actually increase patent challenges arising from weak value propositions, while simultaneously leading to an unintended exchange of resources between the legal and R&D departments: only a temporary fix, at best. Lin et al. (2006) note the inherent danger in this unintended exchange: a firm's technology portfolio has strategic importance, particularly its patent diversity, and correlates with a firm's performance (profitability and shareholder value). The enterprise may handle the patent challenges in short term via more legal review, but the fundamental problem is unsolved; hence, it will reoccur (Braun, 2002).

Innovators and entrepreneurs must expect more lawsuits given the high reward that a protest during PGR may garner: this possible reward encourages not only justifiable claims, but also patent trolls. Enterprises can react to this problem in two ways: covering the symptoms or finding fundamental solutions. The symptomatic solution to this problem is to hire more legal staff to handle the challenges, whereas the fundamental solution is to focus more on the innovation's novelty and utility, especially by crafting a *unique* value proposition for the technology that makes it difficult to challenge. Ernst, Conley, and Omland (2016) imply that successful enterprises will choose the latter to create value from patents.

5. Other, complex questions of interest

Beyond these rather straightforward conversations about *first-to-file*, *best mode*, *prior art*, and *post-grant review*, *systems thinking* (incorporating *generic archetypes*) can be used to enrich the communication about other complex questions and scenarios linked to changes wrought by AIA. To illustrate, consider three scenarios, progressing from simpler to more complex (in terms of numbers and types of research questions and archetypes involved, as well as number of stakeholder perspectives considered):

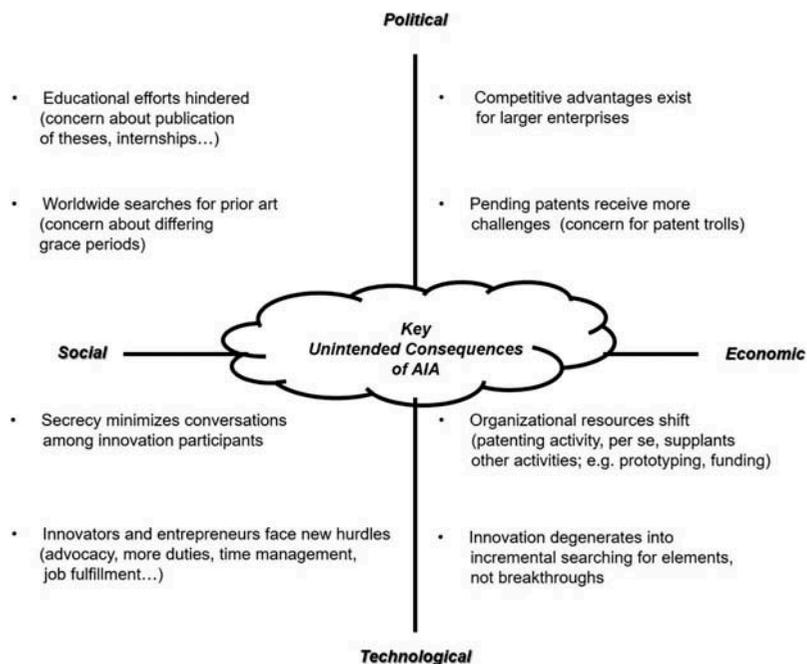
- (1) A small startup wants to gain insight into how the requirements for *Prior Art* might affect the strategy regarding when to file for patent protection and whether or not to use a provisional application. It uses a single archetype, *Escalation*, and interprets outcomes (consequences) from only its own perspective.
- (2) A large, high-technology firm with thousands of patents in electronics wants to investigate how *Best Mode Disclosure* might affect its strategy regarding the number of patents to file, when to file, as well as the appropriate communication mode for establishing claims of *Prior Art*. It uses two archetypes, *Limits to Growth* and *Successful to Successful*, to assess these consequences, all from its own perspective.
- (3) The Association of University Technology Managers (AUTM) wants to perform a large-scale study of how *Prior Art* and *Best Mode Disclosure* requirements may affect member universities' strategies for determining their own number of patent applications, when to file, types and number of claims per patent application, and likelihood of patent infringement suits arising from consciously minimizing *Best Mode Disclosure*. It uses one archetype, *Accidental Adversaries*, and interprets its outcomes from not only its own perspective, but also another stakeholder group—the potential licensees of the patents derived from university research (for example, Saint Louis University, 2009).

6. Working with AIA

Without reflection, we go blindly on our way, creating more unintended consequences, and failing to achieve anything useful. Margaret Wheatley

All in all, the *Leahy-Smith America Invents Act* not only represents an attempt to improve the patent lifecycle, but also signals a need for an expanded and more diverse skill set for all IP stakeholders. Figure 5 summarizes eight key *unintended consequences* that drive this need.

Figure 5. Unintended Consequences of AIA have systemic impacts in the Political, Economic, Social, and Technical spheres for IP Stakeholder.



Political, economic, social, and technological dimensions define the issues. Collectively, Figure 5 suggests that every stakeholder will remain mindful of all options to protect intellectual property and will allocate resources wisely. All will be prepared for more challenges to patents, via both litigation and administrative procedure. All will develop caution regarding grace periods and *prior art*; becoming wary of unintended disclosure over emerging social media or via alliances. When the conversation relates to innovation, intellectual property, and technology portfolios, innovators will re-engineer protocols to help guard against risks.

No doubt AIA also affects the decisions and behaviors of all stakeholder groups involved in technology development and commercialization. Consider the *lone wolf* inventor tinkering in a home garage, or a corporate scientist working in a Federal Laboratory, or a crowd-sourced invention, or allies working to develop an emerging technology [see Schubert (2016) for how innovation partnerships may increase the risks of IP infringement], or myriad, other possible collaborative arrangements. Irrespective of the genesis of the innovation or invention, efforts to protect intellectual property must consider the changes wrought by AIA.

No stakeholders in the patent bargain will be able to escape the pervasive effects of the AIA on their organization and operations. This article serves as a *primer* aimed at improving the strategic communication among all parties about the changing complexities of IP and patent law. While not a substitute for ongoing legal counsel, it offers a systemic view of key changes embodied in AIA. It highlights changes in each of four major areas (*first-to-file*, *best mode* disclosure, expansion of *prior art*, and *post-grant review*). Further, it identifies risks that might flow from these changes. Systems thinking, exemplified by causal loops and generic archetypes, underscores these risks while enabling key stakeholders to communicate better about the protocols needed to mitigate the hidden dangers. Looking ahead, applying systems thinking appears instrumental to former USPTO Director Lee's desire for a better patent system: it allows for holistic communication (Quinn, 2016).

In summary, AIA has laudable goals, but it translates into added concerns for innovators and entrepreneurs. The changes bring added responsibilities. AIA may hinder outreach among corporations and universities (via the cautions in information exchange based on the extension of *prior*

art). AIA, even though it offers possible cost reductions for patent filings and fees, offers greater advantages to larger enterprises that have the resources to devote to integrating a comprehensive and sophisticated evaluation protocol for potential patents within the overall framework of new product development. Most worrisome for society, AIA may change the focus of innovation from breakthrough innovation to incremental improvements.

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