Application Protection
Why bother?

(…and, no, this is not a rhetorical question)

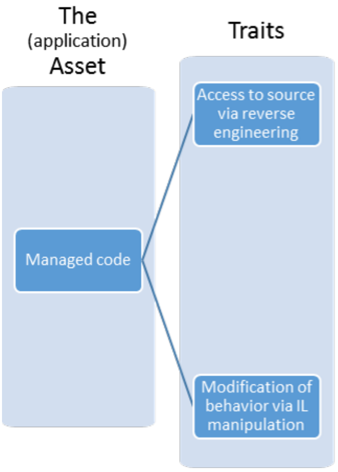
Why should a developer (or parent organization) bother to protect their applications? Given the fact that PreEmptive Solutions builds application security and risk management software, you might think that we are somehow being snarky and rhetorical – but, please be assured, we are not.

The only way to answer such a question is to first know what it is that you need protection from. If the answer is something like “to protect against reverse engineering or tampering,” that is not a productive answer. The answer needs to consider what damage is likely to follow if/when reverse engineering or tampering should occur. Are you looking to protect sensitive data? Prevent piracy? Secure Intellectual Property (IP)? AGAIN – not good enough – the real answer is going to have to be tied to lost revenue, regulatory penalties, operational disruption resulting financial or other damage, etc. Unless and until you can answer these questions – it is impossible to appropriately prioritize your response to these risks.

If you feel this is too pedantic or too academic, then (and forgive me for saying this) you are not the person who should be making these kinds of decisions. If, on the other hand, you’re not sure how to answer these kinds of questions – but you understand (even if only in an intuitive way) the distinction between managing risks (damage) versus preventing events that can increase risk – then I hope the following distillation of how to approach managing the unique risks that stem from developing in .NET and/or Java (managed code) will be of value.

First consideration: managed code is easy to reverse engineer, monitor and modify by design – and there are plenty of legitimate scenarios where this is a good thing.

Your senior management needs to understand that reverse engineering and executable monitoring and manipulation is well understood and widely practiced.

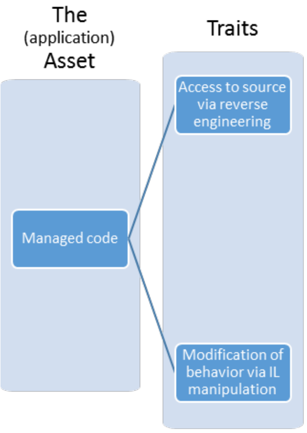

The (application) Asset
Traits
Managed code
Access to source via reverse engineering
Modification of behavior via IL manipulation

It is neither a flaw nor an oversight – the ease with which managed code can be reverse engineered and/or modified after it has been compiled is a well-understood and expected trait inherent in all managed code.

Widely practiced, benign use cases for reverse engineering and executable modification include support, debugging, and instruction.

Therefore, if this common practice poses any material risks to your organization, your organization is compelled to take steps to mitigate those risks – of course, if this basic characteristic of managed code does not pose a material risk – no additional steps are needed (nor should they be recommended),

Second consideration: reverse engineering, debugging and monitoring tools don't commit crimes – criminals do; but criminals have found many ways to commit crimes with these powerful development utilities.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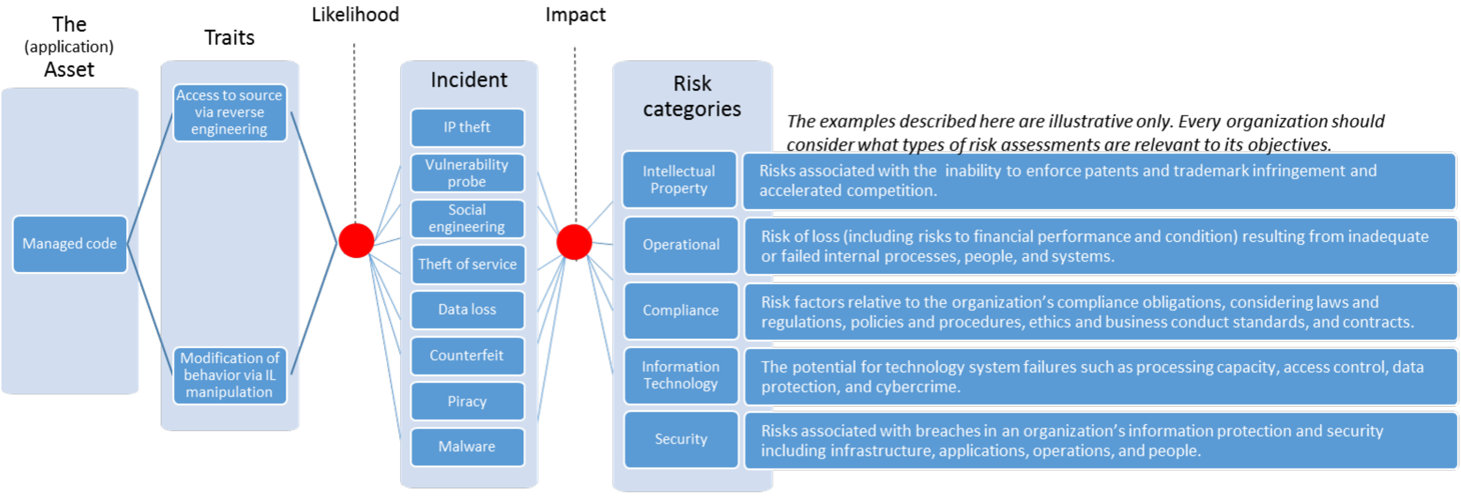
However, unauthorized and malicious use cases are also well-understood and widely practiced.

* Counterfeiting and theft of services have emerged with the rise and dominance of mobile application adoption

Incident	
IP theft	Access to proprietary algorithms, design, and other content.
Vulnerability probe	Static analysis of source code to identify coding security gaps.
Social engineering	Develop exceptional insight into application behavior to suggest identity and provenance of bad actors and apps.
Theft of service*	Spoof account identity of app developers to hijack (and steal) third party services.
Data loss	Alter app behavior and/or identify app transfer patterns and practices.
Counterfeit*	Create alternate, unauthorized versions of apps that can include malicious behavior.
Piracy	Defeat licensing and authentication controls enabling unauthorized use of software.
Malware	Include – through code modification and/or injection – unauthorized application behavior.

In order to be able to recommend an appropriate strategy, a complete list of threats is required – simply knowing that IP theft is ONE threat is not sufficient – if the loss of sensitive data poses an incremental threat – this qualitatively distinct risk must also be captured.

Third consideration: Which of the incident types above are relevant to your specific needs? How important are they? How can you objectively answer these kinds of questions?



The examples described here are illustrative only. Every organization should consider what types of risk assessments are relevant to its objectives.

Intellectual Property: Risks associated with the inability to enforce patents and trademark infringement and accelerated competition.

Operational: Risk of loss (including risks to financial performance and condition) resulting from inadequate or failed internal processes, people, and systems.

Compliance: Risk factors relative to the organization's compliance obligations, considering laws and regulations, policies and procedures, ethics and business conduct standards, and contracts.

Information Technology: The potential for technology system failures such as processing capacity, access control, data protection, and cybercrime.

Security: Risks associated with breaches in an organization's information protection and security including infrastructure, applications, operations, and people.

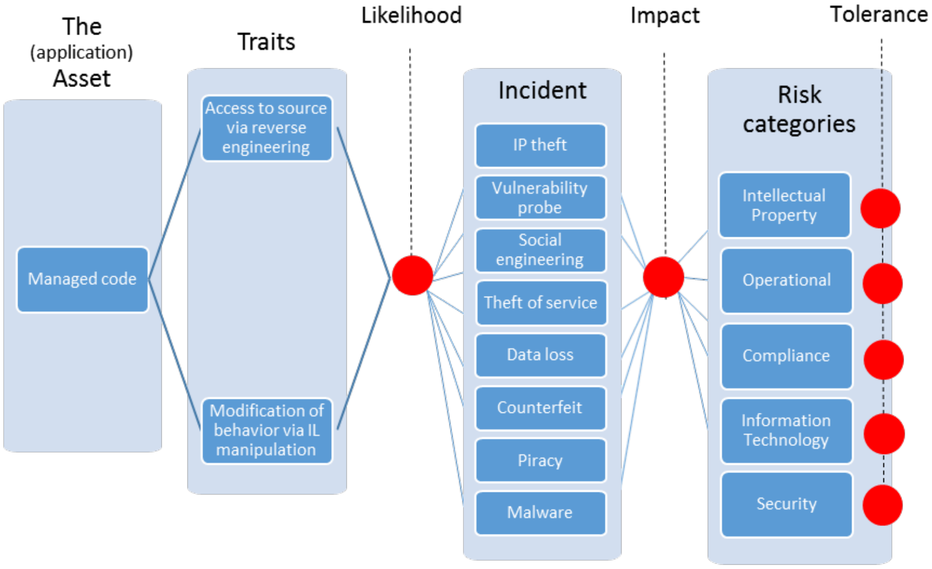
*The **likelihood** of one or more of these "incidents" occurring combined with ...*

*...the **impact** to an organization should an incident occur defines the actual **risk** to that organization.*

Risk management is a mature discipline with well-defined frameworks for capturing and describing risk categories; DO NOT REINVENT THE WHEEL. How significant (material) a given risk may be is defined entirely by the relative impact on well-understood risk categories. The ones listed above are commonly associated with application tampering, monitoring and reverse engineering - but these are not universal nor is the list exhaustive.

Fourth consideration: How much risk is too much? How much risk is acceptable (what is your tolerance for risk)? …and what options are available to manage (control) these various categories of risk to keep them within your organization's "appetite for risk?"

Tolerance (or appetite) for risk is NOT a technical topic – nor are the underlying risks. For example, an Android app developed by 4 developers as a side project may only be used by a small percentage of your clients to do relatively inconsequential tasks – the developers may even be external consultants – so the app itself has no real IP, generates no revenue, and is hardly visible to your customer base (let alone to your investors). On the other hand, if the result of a counterfeit version of that app results in client loss of data, reputation damage in public markets, and regulatory penalties – the trivial nature of that Android really won't have mattered.



*When the weight of the likelihood and impact of an "incident" occurring is deemed to be **intolerably** high, then the resulting risk must either be avoided entirely (stop developing in managed code in this example) or, when avoidance is not an option, the risk must be reduced to a tolerable level through the use of a "**control**."*

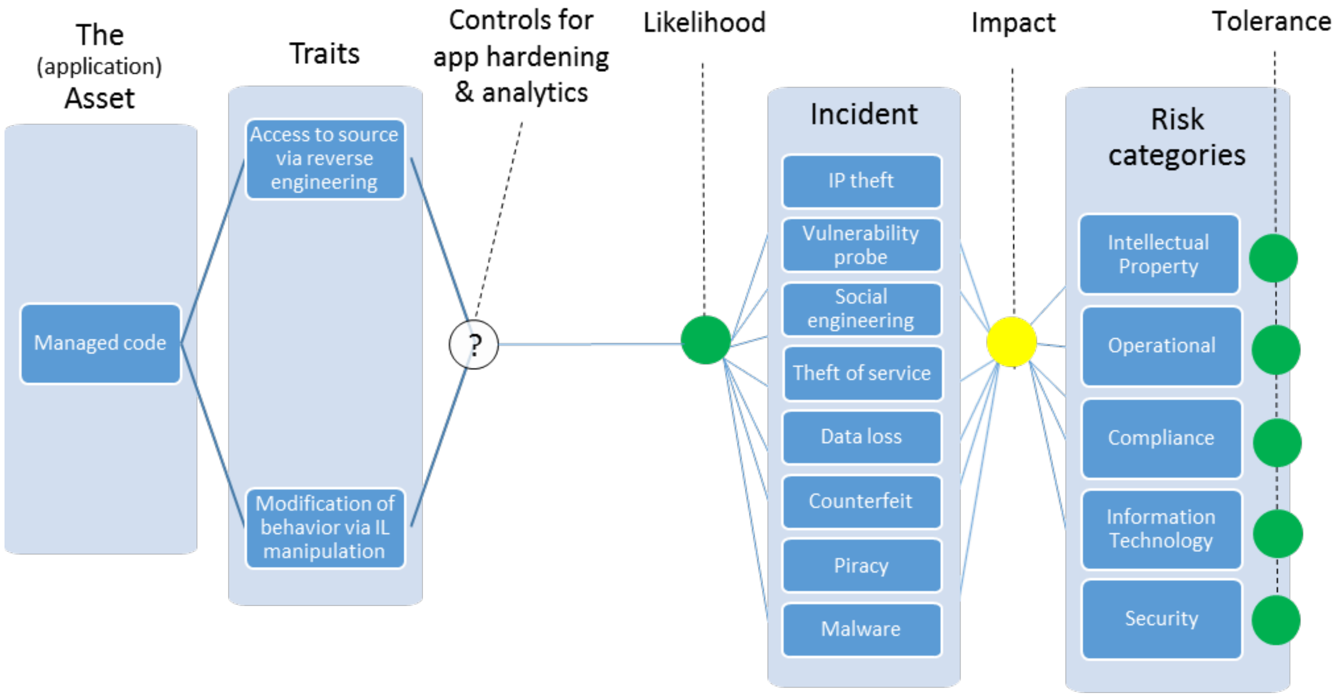
*To be effective, a control must reduce the combined weight of likelihood and impact of an incident occurrence to a "**tolerable**" level.*

Controls do not eliminate risks – controls make risks tolerable.

In other words, even if the technical scope of an application may be narrow, the risk – and therefore the stakeholders – can often be far reaching.

Risk management decisions must be made by risk management professionals – not developers (you wouldn't want risk managers doing code reviews would you?).

Fifth consideration: what controls are available specifically to help manage/control the risks that stem from managed code development?



Controls to mitigate risks stemming from the use of managed code include ***obfuscation*** *to lower the* ***likelihood*** *of an incident occurrence (a preventative control) and* ***tamper detection and defense*** *as well as* ***application monitoring and analytics*** *to reduce the* ***impact*** *should an incident occur (through faster detection and real-time remediation).*

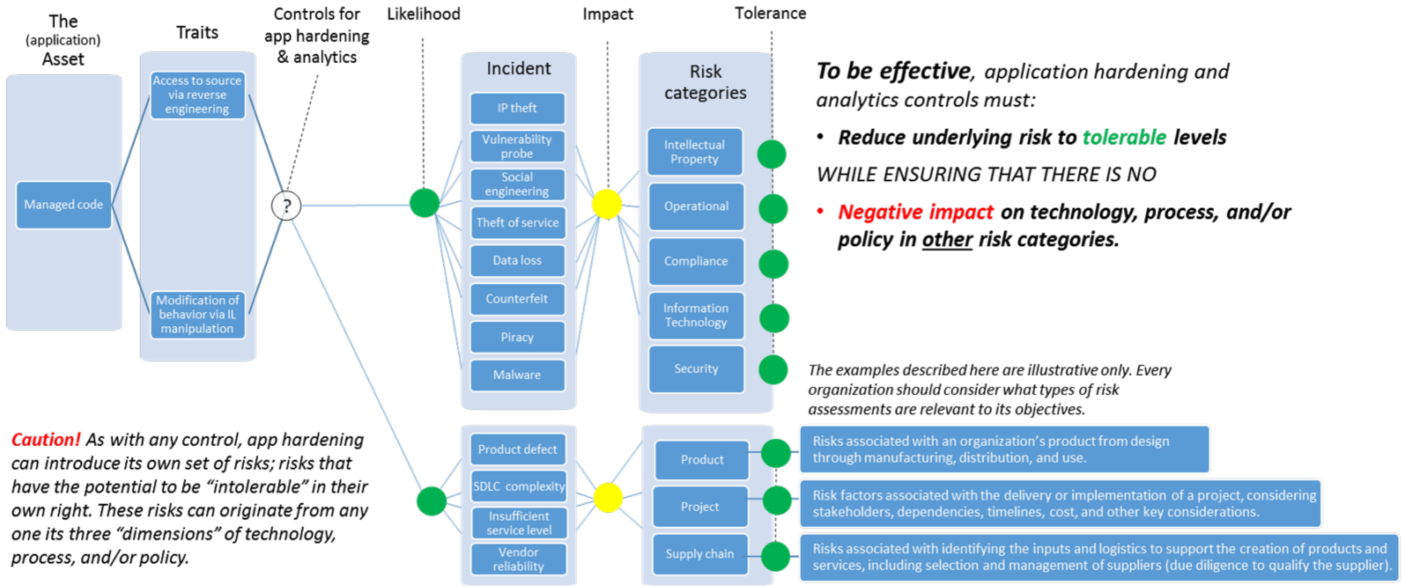
To be effective, the control must combine ***technology*** *to obfuscate and/or monitor applications,* ***processes*** *that detail how to consistently use the technology, and* ***policies*** *that dictate when to invoke these processes – thus ensuring* ***consistent*** *and* ***effective*** *risk mitigation.*

Obfuscation is a portfolio of transformations that can be applied in any number of permutations – each with its own protective role and its own side effects.
Tamper detection and defense as well as regular feature and exception monitoring also have their own flavors and configurations.

Machine attacks, human attacks, attacks whose goal is to generate compliable code versus those designed to modify specific behaviors while leaving others in tact all call for different combinations of obfuscation, rooted device defense (for mobile), tamper defense, and alerts.

The goal is to apply the minimum levels of protection and monitoring required to bring identified risks levels down to an acceptable (tolerable) level. Any protection beyond that level is “over kill.” Anything less is wasted effort. …and this is why mapping all activity to a complete list of risks is an essential first step.

Sixth consideration: the cure (control) cannot be worse than the disease (the underlying risk). In other words, the obfuscation, anti-debugger, anti-emulator, anti-root and tamper defense solutions cannot be more disruptive than the risks these technologies are designed to manage.



To be effective*, application hardening and analytics controls must:*

- ***Reduce underlying risk to tolerable levels***

WHILE ENSURING THAT THERE IS NO

- ***Negative impact on technology, process, and/or policy in other risk categories.***

The examples described here are illustrative only. Every organization should consider what types of risk assessments are relevant to its objectives.

Risks associated with an organization's product from design through manufacturing, distribution, and use.

Risk factors associated with the delivery or implementation of a project, considering stakeholders, dependencies, timelines, cost, and other key considerations.

Risks associated with identifying the inputs and logistics to support the creation of products and services, including selection and management of suppliers (due diligence to qualify the supplier).

***Caution!** As with any control, app hardening can introduce its own set of risks; risks that have the potential to be "intolerable" in their own right. These risks can originate from any one its three "dimensions" of technology, process, and/or policy.*

Focusing on the incremental risks that introducing obfuscation, anti-debugger, tamper defense, and other real-time detection and response controls can introduce is an essential part of the process. The following questions are often important to consider (this is a representative subset – not a complete list):

* Complexity of configuration
* Flexibility to support build scenarios across distributed development teams, build farms, etc.
* Debugging, patch scenarios, extending protection schemes across distinct components
* Marketplace, installation, and other distribution patterns
* Support for different OS and runtime frameworks
* Digital signing, runtime IL standards compliance, and watermarking workflows
* Mobile packaging (or other device specific requirements)
* For commercial products, vendor viability (will they be there for you in 3 years) and support levels (dedicated trained team? response times?)

So when should you protect your applications?

Only when your organization has well-defined risks that are unacceptably high (financial, operational, compliance …) AND the recommended risk management controls (technology + process + policy) reduce risk levels to acceptable limits WITHOUT introducing unacceptable incremental risks or expenses.