

A Critical View on CIS Controls

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Abstract—CIS Controls is a set of 20 controls and 171 sub-controls that were created with an idea of having a list of something to implement so that organizations can increase their security. While good in theory, it is a big question of how viable this approach is in practice, and does it really help. There is only a minor number of critical views of CIS Controls and since CIS Controls are marketed by two very influential organizations they are very popular. Yet, there are alternatives published by ISO, NIST and even PCI consortium. In this paper we critically assess CIS Controls, assumptions on which they are based as well as validity of approach and claims made in its favor. The conclusion is that scientific community should be more active regarding this topic, but also that more material is necessary. This is something that CIS and SANS should support if they want to make CIS Controls viable alternative to other approaches.

Index Terms—cis controls, risk assessment

I. INTRODUCTION

CIS Controls is a name for a set of 20 controls that are marketed as having the best ratio between resources spent on security protection and gains achieved by lowering the risk of being compromised. CIS Controls are heavily marketed by Center for Internet Security which is the owner of those controls, and SANS Institute that initiated the creation of 20 critical security controls and had ownership rights for some time under the name of *20 critical security controls*.

Due to marketing push by CIS and SANS, on the Internet there are a lot of materials available related to these controls, including two courses offered by SANS SEC566 [1] and SEC440 [2]. In general, these materials largely explain what CIS Controls are, are copies of information available from the documents produced by

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CIS [3], or deal with how to implement those controls in some environment.

In the same time, it is very hard to find critical review of CIS Controls in general, and the scientific scrutiny regarding CIS Controls is missing. This is worrisome for two reasons. The first one is the obvious ignorance by scientific community of something used very intensively in practice, and the second reason is the simple fact that no technology is a silver bullet regarding security. To make a proper decision every decision maker must have a balanced view on the technology, solution or whatever he or she prepares to use.

The goal of this paper is to provide a critical view on CIS Controls and try to place them within the whole ecosystem of different controls, and security governance in general. We are not going to analyze specific technical aspects of the controls, as this warrants a paper for itself, but instead we'll analyze surrounding claims made about CIS Controls in different documents, assumptions underlying CIS Controls, and the validity of the approach taken by CIS Controls to secure IT systems. Finally, we'll also give some recommendations regarding how to improve identified shortcomings and also give some pointers of potential work that can be done by scientific community.

The paper is structured in the following way:

- Section II gives an overview of CIS controls, its history and related documents that form a security framework.
- Section III critically analyzes claims that can be found in the literature regarding CIS Controls.
- Section II-C compares CIS controls with other available controls and security frameworks.
- Section IV lists what should be done in order for CIS Controls to become more credible.

II. CIS CONTROLS

In this section we give a short overview of CIS Controls. We are not going into depth since it is not necessarily for the understanding of the rest of the paper. Only necessary basics are covered.

A. Overview

CIS Controls are defined and described in a document published by Center for Internet Security [4]. At the time this paper was written the latest version was 7.1. published in April, 2019. CIS published several other guides in which they detail the application of CIS Controls in some specific environments, like in cloud [5], Internet of Things [6], etc. But we will ignore those as they are not important for the main point of this paper.

Each of 20 CIS Controls is further subdivided into sub-controls, and in total there are 171 sub-control across all 20 controls. The 20 controls are divided into three groups, i) basic, ii) foundational, and iii) organizational. Since the number of sub-controls is quite large and it is hard to expect that they are fit for everyone, starting from version 7 of CIS Controls specification, *implementation groups* were introduced, three groups in total. In essence, the idea is that the smallest enterprises implement only implementation group 1 while the largest enterprises implement all three implementation groups.

The basic idea behind CIS Controls is that there is so much information available on the Internet regarding protection of information systems that it become contra-productive, basically making things worse, i.e. less secure. This is what CIS in documents specifying controls calls *fog of more* [4]. So, the approach taken to remedy this situation is to have a single source of information with cut-down version of proposed controls to be implemented.

B. History & Development

The only source of information about development of CIS Controls is a SANS Institute Web page that contains narrative about its history [7]. Searching on the Internet it is possible to find other sources too, like e.g. [8] which is very high in Google search results, but all of them basically repeat information from the SANS Institute Web page. CIS Controls had a fore-runner but it was done for the US Government by the US Government and thus it was not publicly released.

CIS Controls started as an initiative by CIS and SANS when they contacted NSA with a proposal to develop cut-down version of controls that will stop and detect most attacks in existence. In due course a number of

companies and institutions joined the initiative started by SANS and CIS. Finally, in 2009. the first version of CIS Controls was published. The current version is 7.1 published in April 2019 as controls are reviewed on an annual basis.

The initial ownership on CIS Controls had SANS which called it *20 critical security controls* but transferred it to Council on Cyber Security (CCS), and finally in 2015 to Center for Information Security [9].

In the historical overview of development of CIS Controls, SANS gives a certain number of claims in favor of CIS Controls, but which are of dubious value. We'll get to that later in the paper.

C. Other Frameworks

CIS Controls are not the only catalog of controls that can be found on the Internet. There's ISO 27001 [10], NIST Special Publication 800-53, Revision 5 [11], NIST Cyber Security Framework v1.1 [12], and PCI-DSS [13].

ISO 27001 is part of the ISO 27000 series which is a comprehensive framework for security management, thus something much larger than CIS Controls. In Appendix A of ISO 27001 there are total of 114 controls grouped into 14 clauses [10].

NIST Special Publication 800-53r5 which is in draft status has 294 controls grouped into 20 categories. This is twice more than the number of sub-controls recommended by CIS.

PCI-DSS was created by card companies and, unlike others, is specific to financial industry. It is created with a specific purpose to protect cardholder data. So, it's narrower in scope than CIS Controls, and especially other frameworks.

The key difference between CIS Controls and other frameworks is that CIS Controls are something you should implement, while all the others are something you choose from based on risk assessment you've done. In other words, in case of CIS Controls someone already did risk assessment for you, have chosen controls to implement and then handed over the list to you.

D. Related Work

To the best of author's knowledge, the only critical view on the CIS Controls is a blog post written by Ben Tomhave in 2011 [14]. The key claims of his post regarding CIS Controls are:

- 1) they're not controls,
- 2) they're not scalable, and
- 3) they're designed to sell a product.

The first claim revolves around the somewhat philosophical question of what is *control* and *control state-ment*. The author believes that for something to be control it has to be actionable, i.e. stated in such a way to allow someone to do something specific or to perform some action. Based on that premise the author argues that CIS Controls are actually not controls but wish list. The second claim is about company size, i.e. that those controls are not applicable to companies of all sizes but only for the largest ones. The basis for such thinking is, for example, Data Loss Prevention suggested by CIS Controls is supposedly not applicable for everyone. Finally, in the third claim Tomhave argues that the 20 critical controls advocate specific products, and even specific vendors.

In the same post Tomhave also draws attention to the fact that CIS Controls miss policies, governance and risk management approach.

III. CRITICAL VIEW ON CIS CONTROLS

We can analyze CIS Controls from several different perspectives. The first one is related to the whole idea of having certain number of selected controls that everyone uses to improve security. This is done in subsection III-A. Related to the idea of having a specific number of controls itself are assumptions, implicit and explicit, and context for development of CIS Controls. This analysis is presented in subsection III-B. The third view concerns with question on how the controls were selected, i.e. what was the process used to determine which controls are better than the others. This is done in subsection III-C. Finally, the fourth view is about the claims made by CIS and SANS in favor of CIS Controls. Those are analyzed in subsection III-D.

Note that it is also possible to analyze controls themselves, as well as recommendations given. But this has been left for future work.

A. Validity of CIS' Approach to Security

By *validity* of CIS' approach we mean three different things.

1) *Governance*: CIS Controls started as an idea of selecting a certain number of controls that have the best ratio of resources invested into implementing controls and security gains achieved, i.e. you would take the list and start to implement everything on the list starting from the first one and finishing with the last one.

The problem with this approach is how useful it is in practice with respect to the governance of the security. To illustrate, let's say you were named CISO in some

company and your task it to make it secure. CIS Controls were made with an assumption that you, as a CISO, don't ask anything but immediately start with implementing controls. But, as CISO, your first task would be to assess current state of the security, which is done via risk assessment process. This is in a contradiction with CIS Controls initial idea as they assumed they did risk assessment for you.

Risk assessment is something very dependent on particular context, and there's no way to have anything even remotely resembling universal risk assessment, i.e. having something that will be reusable. It's always necessary to adjust to specific environment. And, actually, the document about CIS Controls is specific about that [?]:

But this is not a one-size-fits-all solution, in either content or priority. You must still understand what is critical to your business, data, systems, networks, and infrastructures, and you must consider the adversary actions that could impact your ability to be successful in the business or operations. Even a relatively small number of Controls cannot be executed all at once, so you will need to develop a plan for assessment, implementation, and process management.

In other words, what this quote says is that you still need to do a risk management, and in particular risk assessment process. Finally, in April 2018, CIS introduced CIS RAM [15] which means that the whole CIS Controls initiative was back on what it tried to not be, i.e. risk management process.

With all this development in the CIS approached other frameworks, most notably the ones specified by NIST.

2) *Target Users*: It is unclear to whom are these controls targeted, small, medium or large enterprises. The fact is, those are vastly different, at least small and medium enterprises on one hand and large enterprises on the other hand. This was, in some sense, also recognized by CIS which published a separate white paper detailing implementation of CIS Controls in SMEs [16], but also by introducing implementation groups in the version 7 of the specification.

The bigger the organization is, the more planning and prioritization is necessary. Planning and prioritization is a direct consequence of performing risk assessment. Furthermore, to implement controls it is necessary to have appropriate management structure which, with a number of users, increases. CIS doesn't say anything

about that, so this suggests that CIS Controls aren't fit for large enterprises.

It could be argued that in large organizations there are already such governance structures and that in such cases they could use CIS Controls and manage the process. The problem with this argument is that, if there are already appropriate governance structures, they probably already know what to do, and besides, in such cases maybe ISO 27001 is more appropriate to be used. Not to mention that in such cases there are probably no problems with *fog of more*.

B. Assumptions underlying CIS Controls

CIS Controls document is contradictory in that it lists security controls that you can implement. And, in order to be able to do so, risk assessment had to be performed by the people and organizations developing CIS Controls. Namely, they assessed which vulnerabilities are the most critical ones, and they then suggested which controls should be applied to lower the risk.

But then it warns you that,

... this is not a one-size-fits-all solution, in either content or priority. You must still understand what is critical to your business, data, systems, networks, and infrastructures, and you must consider the adversary actions that could impact your ability to be successful in the business or operations. Even a relatively small number of Controls cannot be executed all at once, so you will need to develop a plan for assessment, implementation, and process management.

In other words, it allows you to skip over risk assessment process, and to jump straight into risk control part of risk management process, and in particular into reduction of the risk. But then, it suggests to you to develop a some kind of a plan, which requires at least some steps from risk management process.

We have several problems there. *The first* one is that CIS Controls document in the same time gives you controls to implement and warns you that you still need to assess your security. So, if implemented properly, how are CIS Controls different that other risk management approaches that come with catalog of controls? *The second* problem is related more to how people behave, that is, they don't read fine print. In other words, many people/organizations will start to implement controls, without knowing is that good for their specific situation or not. CIS guide for SMEs [16] goes even further than that, it suggests using someone within the company that

is otherwise not related to security to guide the process of control implementation. This makes thing even worse because security shouldn't be done by the people not knowing security, and without proper governance structure - no matter how thin.

Also, quite explicit assumption is that you, as someone taking care of security, are lost in lot of information, i.e. *fog of more*. This is actually debatable, since we might ask, if you, as a professional, are lost in lots of information then are you professional at all, at least security professional? Namely, one of the skills professionals have is to know what is important and what is not, and more importantly, to build their own methods and processes by which they work. So, *fog of more* doesn't sound like a real problem, at least not for security professionals. Especially it doesn't sound as right approach to solve it by giving people something simple instead of trying to teach them how to handle that situation.

Anyway, turns out that CIS Controls could be beneficial to some small number of companies that for whatever reason can not afford security personnel (in-house or out-sourced) but need to deal with security issues. At least that was the case until CIS published risk management methodology [15] which potentially made CIS Controls harder for use for such companies.

C. CIS Controls Development Process

As we already stated, the only source of information about the development of CIS Controls available is a document describing how CIS controls were developed. Unfortunately, that is far from enough for any objective evaluation of CIS Controls. Furthermore, there is a number of claims and arguments made in favor of CIS Critical Controls which are of dubious value. We review them in the next subsection.

What is known about development process is the following [7]:

- 1) We know a large number of organizations and people participated.
- 2) Participants discussed a lot about which controls to include.
- 3) There was a period of public consultations on which over 50 comments were received.

The main argument for CIS Controls is given by emphasizing that a large number of high-profile organizations participated in the development, like UK's CESG and CPNI, the DoD chief computer network architect, etc. This is a great example of *appeal to authority* argumentation [17]. No serious technology should be

based on who did it, but on how it was done. In this case, more transparency in how things were organized, what decisions were made, who did what, and so on would be much more useful than enumerating participants.

When speaking about large number of people and organizations participating in the development of something the question that arises is how they aggregated data they received from participants.

To conclude, no written trace of development activities is available, at least not publicly. This is problematic and should be corrected by publishing working papers as well as reports that will allow scrutiny, and validation, of the process and its outcomes.

D. Claims made about CIS Controls

When controls were selected and prioritized during development of CIS controls, the guiding principle was that *no control should be made a priority unless it could be shown to stop or mitigate a known attack* [7]. The question that immediately pops up is, what is regarded as a *known attack*? Attacks are different, and have their own specifics. So, knowing attack at one organization doesn't mean we are immediately knowing attacks in some other organization. What is probably meant by the phrase known attack are *techniques and tactics* [18] that are used to perform attack which are much more stable and common.

Next claim about CIS Controls is that it is the best practice [4]. To analyze the validity of this claim let's start with the definition of the term *best practice*. According to Merriam-Webster *best practice* is defined as [19]:

a procedure that has been shown by *research* and *experience* to produce *optimal results* and that is established or proposed as a standard suitable for widespread adoption

So, in order for something to be regarded as best practice, research and experience has to show that it produces optimal results. There's no research regarding CIS Controls, so we are left with experience. On the other hand, the only experience available are anecdotal claims made in some of the documents promoting CIS Controls. There are no documents recording experiences and that makes this claim hard to fact check. So, it is left as an open question if CIS Controls are best practice, or not.

Yet another claim about the usefulness of CIS Controls, which additionally might support claim of being best practice, is the following one [7]:

In June 2012, the Idaho National Laboratory, home of the National SCADA Test Bed, of the U.S. Department of Energy, completed a very favorable analysis of how the CIS Critical Controls applied in the electric sector as a first step in assessing the applicability of the controls to specific industrial sectors.

It is very hard, almost impossible to find source of this claim. Additionally, what is meant by *favorable analysis*? How can that be checked, and validated by doing the same analysis by someone else?

There are also another claim in favor of CIS Controls [4]:

In 2009, the U.S. Department of State validated the consensus controls by determining whether the controls covered the 3,085 attacks it had experienced in FY 2009. The State Department CISO reported remarkable alignment of the consensus controls and the State Department actual attacks.

This claim opens up more questions than it manages to give answers. How this validation has been performed? What were results for each one attack? What kind of attacks were those? How severe they were? What does *alignment* mean? How was alignment measured to be able to state that there is remarkable alignment? No data has been published, and thus nothing can be checked about these claims making them nothing more than a marketing speak.

Next, there is a statement about reduction of vulnerability based risk which CIS Controls allow [7] which is widely copied around (e.g. few top results from Google search [20][21][22]):

With a very rapid achievement of a more than 88% reduction in vulnerability-based risk across 85,000 systems, the State Department's program became a model for large government and private sector organizations.

This quote, and specific numbers mentioned, open up a number of questions. First, what is *vulnerability-based risk*? We might speculate that it is risk calculated only based on known vulnerabilities, but it would be better that this is clearly stated. Next, question is how did they calculate or measure this reduction? Did they analyze all 85,000 systems, and if so, how? To do anything across such a large number of systems is very demanding. Not to mention that knowing what is there is also demanding.

To conclude, it is clear that a number of claims is made in favor of CIS Controls, yet none of these claims

can be independently verified. Also very important is that security is a fast moving field, what was valid few years ago, doesn't have to be valid today. So, even though CIS has annual reviews of CIS Controls, all the claims about it are not revalidated.

IV. WHAT NEEDS TO BE DONE

So, it is obvious that further work is necessary that will evaluate true usefulness of CIS Controls. But, we should be clear from whom we might expect objective evaluation. For example, there are case studies available on the CIS Web page [23], but all of them are primarily marketing type of materials meant to persuade someone to use CIS Controls. There is one report written as a part of GIAC (GCCC) Gold Certification in 2016 [24], but it is also not enough.

We argue that more scientific analysis is necessary in order to make CIS Controls more viable alternative for making systems more secure. To get to that conclusion it is necessary to analyse incentives of stakeholders in the ecosystem built around CIS Controls. The stakeholders in this system are:

- Center for Internet Security (CIS) – who has ownership of CIS Controls,
- SANS – who started work on CIS Controls and also gives courses that teach CIS Controls,
- solution vendors – that offer solutions for the implementation of CIS Controls, and
- users – who implement CIS Controls in order to protect themselves.

For each stakeholder, the following questions should be asked:

- What they can gain/lose by criticizing CIS Controls?
- What they can gain/lose by ignoring CIS Controls?
- Do they have incentive to thoroughly analyze CIS Control benefits?

No stakeholder has an incentive to contradict validity and usefulness of CIS controls, or to say they are no better than other approaches. CIS and SANS started everything and to suddenly claim it doesn't work would be disastrous for them. In addition, SANS has very expensive courses built on CIS Controls. Solution vendors will happily sell anything customers believe works, and have absolutely no incentive to say it doesn't help, or that it helps a lot less than people think. Users might be an exemption, but people tend not to criticize something they did (otherwise, they did it for no purpose). Also, users tend to rely on vendors' opinion and what they can find

on the Internet. Finally, users tend to believe authorities and seek protection from authorities. Namely, if incident happens even though CIS Controls are implemented, it will have repercussions less likely since *everybody* is doing it.

The conclusion is that CIS Controls have to be validated by someone not having a stake in them, and that ones are scientist that should perform scientific analysis. But scientist can not analyze something that is not described, so scientist should be given access to specific CIS Controls implementations, or at least there should be better case studies published.

So, the following work is necessary to perform in order to make CIS Controls more credible:

- Papers describing experience/case-studies with the implementation of CIS Controls
- Describe context in which CIS Controls were decided to be used
- What controls and in which order were they implemented?
- How well were they implemented? What problems were encountered?
- How effective they are? Were there breaches?
- Surveys and reviews of experience papers
- Synthesis and generalization of results presented in the case-studies
- Critical assessment of experience/case-studies papers

V. CONCLUSIONS AND FUTURE WORK

CIS Controls started as a quest for the simple solution that will solve majority of security problems for everyone. The solution should be preferably plug-and-play, or at most "Next-Next-Finish". And for some time it was marketed as such even though there was fine print about knowing your system before doing anything. But as time progressed, and the whole idea evolved about having ready-made controls to implement evolved it ended up being one more risk management solution with accompanying catalog of controls to be chosen from, only this time (maybe) somehow reduced.

The fact is that cyber security and information security are not easy, no matter how much we tried to make them such. In part this is because they are very context dependent, which make it questionable if a one-size-fits-all solution will ever exist.

CIS Controls are heavily marketed by the simple fact that CIS and SANS are very influential organizations, and in this marketing certain statements are made that are vague, can not be checked, or are simply wrong.

In the end, any protection is better than none, but also not all protections are equally good. So, deeper analysis is necessary of gains achieved by using CIS Controls when compared to other options, and in the end when no protections are used at all in some structured way. We suggested some tasks that could be done in order to improve things, but much is on CIS and SANS.

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