

Fast Iteration Tools in The Production of The Talos Principle

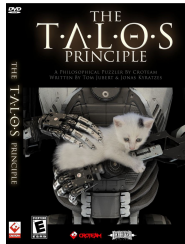
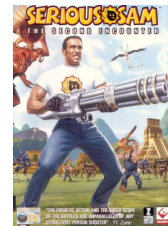
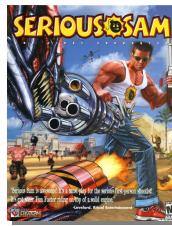
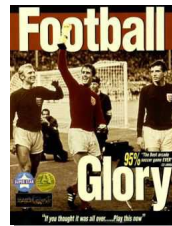
Alen Ladavac
CTO, Croteam



GAME DEVELOPERS CONFERENCE™ EUROPE
CONGRESS-CENTRUM OST KOELNMESSE · COLOGNE, GERMANY
AUGUST 3-4, 2015



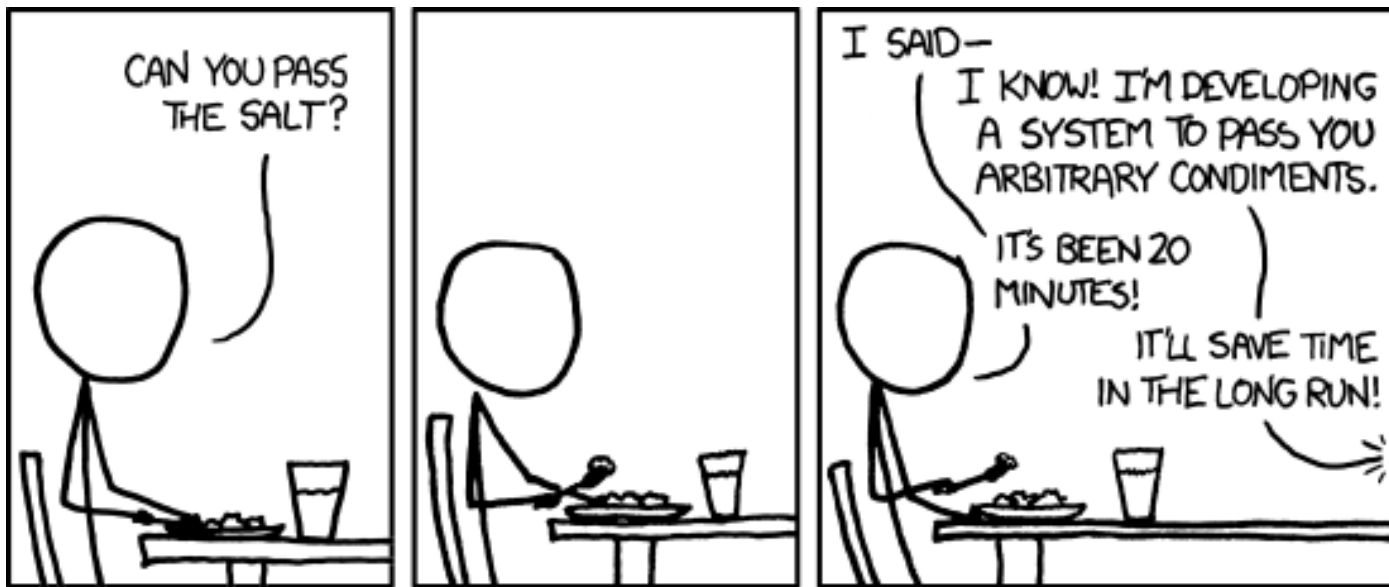
- 20 years in existing...
- a dozen of top-ranking games...
- ...only 25 people at most





It's the mindset that matters...

- Will demonstrate how the tools are used
- Won't explain the implementation
 - The approach is more important



(c) Randall Munroe
xkcd.com

A staged example...



How to report a bug?

- Write it down on paper?
- Alt-Tab into a bug reporting app?
- Fact: Writing bug reports is long, boring and distracting.

So bugs don't get reported

Can we improve on that?








“World Bugs System”

- Reporting inside the “game world”
- Press one key & type short description
- <10 seconds. Literally.
- Automatically stores position.





244414	2015-07-27 11:14:52 (4h 17m ago)			main-Talos_Executables-Linux-Final-builder102 DONE SETUP (buildtime: 2m)
244414	2015-07-27 11:12:44 (4h 19m ago)			main-Talos_Executables-OSX-Final-builder01.croteam.local DONE SETUP (buildtime: 2m)
244414	2015-07-27 11:12:33 (4h 19m ago)			main-Dev-Windows-builder12 DONE SETUP (buildtime: 1m)
244414	2015-07-27 11:12:15 (4h 20m ago)			main-SeriousSam3_Executables-Linux-Final-builder102 DONE SETUP (buildtime: 1m)
244414	2015-07-27 11:09:52 (4h 22m ago)	robert.sajko		<ul style="list-style-type: none"> o Gatekeeper now stores marked changes in a text file, to provide an equivalent of 'integration memory' from the script-based o 2015-07-27 09:09:52Z robert.sajko Settings: normal;
244413	2015-07-27 11:05:48 (4h 26m ago)			Talos_PC_dev-Talos-PS4-builder03 DONE SETUP (buildtime: 1h 1m)
244413	2015-07-27 10:41:33 (4h 50m ago)			Talos_PC_dev-Dev-Windows-builder06 DONE SETUP (buildtime: 0m)
244413	2015-07-27 10:26:33 (5h 5m ago)			Talos_PC_dev-Talos-Android-Final-builder15 DONE SETUP (buildtime: 22m)
244413	2015-07-27 10:06:27 (5h 25m ago)			Talos_PC_dev-Talos_Executables-Linux-Final-builder102 DONE SETUP (buildtime: 2m)
244413	2015-07-27 10:06:26 (5h 25m ago)			Talos_PC_dev-Talos_Executables-OSX-Final-builder01.croteam.local DONE SETUP (buildtime: 2m)
244413	2015-07-27 10:02:57 (5h 29m ago)	goran.adrinek		<ul style="list-style-type: none"> o Fixed problems in Gehenna dialogs caused by freeing the admin before freeing anyone else: now you will be locked out of Ge o 2015-07-27 08:02:57Z goran.adrinek Settings: normal; Talos_Android_distro:integrate, Talos_PC_distro:integrate, Talos_PS4
244411	2015-07-27 11:53:40 (3h 38m ago)			main-Talos-Windows-Final-builder06 DONE SETUP (buildtime: 1h 10m)
244411	2015-07-27 10:16:03 (5h 16m ago)			main-Talos-Android-Final-builder13 DONE SETUP (buildtime: 29m)
244411	2015-07-27 09:49:39 (5h 42m ago)			main-SeriousSam3_Executables-Linux-Final-builder102 DONE SETUP (buildtime: 1m)
244411	2015-07-27 09:48:11 (5h 44m ago)			main-Dev-Windows-builder12 DONE SETUP (buildtime: 1m)
244411	2015-07-27 09:47:30 (5h 45m ago)			main-Talos_Executables-OSX-Final-builder01.croteam.local DONE SETUP (buildtime: 2m)
244411	2015-07-27 09:46:34 (5h 46m ago)			main-Talos_Executables-Linux-Final-builder102 DONE SETUP (buildtime: 1m)
244411	2015-07-27 09:44:53 (5h 47m ago)	robert.sajko		<ul style="list-style-type: none"> o WIP: Gatekeeper no longer sets flags on changelists for AIS daemon to pick up and integrate. Instead, all integrations on gat o clicking Integrate. Changelist selection is preserved when refreshing the UI, e.g. when submitting a manual integration which r o 2015-07-27 07:44:52Z robert.sajko Settings: normal;
244410	2015-07-27 10:39:37 (4h 53m ago)			main-Talos-Windows-Final-builder06 DONE SETUP (buildtime: 1h 9m)
244410	2015-07-27 09:59:49 (5h 32m ago)			main-SeriousSam3-Windows-Final-builder10 FAILED @244410 Bug42900
244410	2015-07-27 09:39:33 (5h 53m ago)			main-Talos-Android-Final-builder13 DONE SETUP (buildtime: 29m)
244410	2015-07-27 09:13:28 (6h 19m ago)			main-Talos_Executables-Linux-Final-builder102 DONE SETUP (buildtime: 2m)
244410	2015-07-27 09:11:14 (6h 21m ago)			main-Talos_Executables-OSX-Final-builder01.croteam.local DONE SETUP (buildtime: 2m)
244410	2015-07-27 09:10:36 (6h 21m ago)			main-SeriousSam3_Executables-Linux-Final-builder102 DONE SETUP (buildtime: 1m)
244410	2015-07-27 09:10:23 (6h 22m ago)			main-Dev-Windows-builder12 DONE SETUP (buildtime: 1m)
244410	2015-07-27 09:08:05 (6h 24m ago)	helena.hunski		<ul style="list-style-type: none"> o Compressed blend mask Stain02.tex. o 2015-07-27 07:05:28Z helena.hunski Settings: normal;
244408	2015-07-27 05:30:45 (10h 1m ago)	nathan.brown		<ul style="list-style-type: none"> o Added source files to EditKit_Base VS project. o 2015-07-27 03:30:35Z nathan.brown Settings: normal;

Talos_Android_dev	Talos-Android-Final	builder02	2015-07-15 06:38:01 (8h 11m ago) DONE @242701	2015-07-15 06:38:01 (8h 11m ago) SETUP @242701
Talos_Android_dev	[integration]	odin	2015-05-26 13:51:28 (50d 0h 57m ago) DONE @231761	N/A
Talos_Android_distro	Talos-Android-Final	builder14	2015-07-15 05:46:16 (9h 2m ago) DONE @237086	2015-07-15 05:46:16 (9h 2m ago) SETUP @237086
Talos_Android_distro	[integration]	odin	2015-05-26 14:01:42 (50d 0h 47m ago) DONE @231826	N/A
AutoTest	Talos_PC_dev-Talos-Windows-Final	tester01	2015-07-15 14:38:02 (11m ago) testing @243742	2015-07-15 14:04:21 (44m ago) NO SETUP @243734
Talos_PC_dev	Dev-Windows	builder06	2015-07-15 14:01:43 (47m ago) DONE @243742	2015-07-15 14:01:43 (47m ago) SETUP @243742
Talos_PC_dev	Talos-Android-Final	builder15	2015-07-15 14:37:11 (11m ago) DONE @243742	2015-07-15 14:37:11 (11m ago) SETUP @243742
Talos_PC_dev	Talos-PS4	builder03	2015-07-15 14:45:35 (3m ago) building @243742	2015-07-15 14:43:00 (6m ago) SETUP @243734
Talos_PC_dev	Talos-Windows-Final	builder07	2015-07-15 14:36:28 (12m ago) DONE @243742	2015-07-15 14:36:28 (12m ago) SETUP @243742
Talos_PC_dev	Talos_Executables-Linux-Final	builder02	2015-07-15 14:02:33 (46m ago) DONE @243742	2015-07-15 14:02:33 (46m ago) SETUP @243742
Talos_PC_dev	Talos_Executables-OSX-Final	builderm01.croteam	2015-07-15 14:02:50 (46m ago) DONE @243742	2015-07-15 14:02:50 (46m ago) SETUP @243742
Talos_PC_dev	[integration]	odin	2015-06-11 17:19:23 (33d 21h 29m ago) DONE @236344	N/A
AutoTest	Talos_PC_distro-Talos-Windows-Final	tester01	2015-07-15 01:14:32 (13h 34m ago) FAILED @243663 Bug42770 suspects:	2015-07-15 00:24:35 (14h 24m ago) NO SETUP @243663
Talos_PC_distro	Talos-Windows-Final	builder14	2015-07-14 16:11:33 (22h 37m ago) DONE @243663	2015-07-14 16:11:33 (22h 37m ago) SETUP @243663
Talos_PC_distro	Talos_Executables-Linux-Final	builder02	2015-07-14 15:44:03 (23h 5m ago) DONE @243663	2015-07-14 15:44:03 (23h 5m ago) SETUP @243663
Talos_PC_distro	Talos_Executables-OSX-Final	builderm01.croteam	2015-07-14 15:41:59 (23h 7m ago) DONE @243663	2015-07-14 15:41:59 (23h 7m ago) SETUP @243663
Talos_PC_distro	[integration]	odin	2015-06-15 10:18:35 (30d 4h 30m ago) DONE @232862	N/A
Sam3_PS3_dev	Dev-Windows	builder12	2015-07-15 00:10:55 (14h 38m ago) DONE @222698	2015-07-15 00:10:55 (14h 38m ago) SETUP @222698
Sam3_PS3_dev	SeriousSam3-PS3	builder13	2015-07-15 01:19:24 (13h 29m ago) DONE @222698	2015-07-15 01:19:24 (13h 29m ago) SETUP @222698
Talos_PS4_dev	Dev-Windows	builder01	2015-07-15 12:51:57 (1h 57m ago) DONE @243736	2015-07-15 12:51:57 (1h 57m ago) SETUP @243736
Talos_PS4_dev	Talos-PS4	builder04	2015-07-15 13:32:51 (1h 16m ago) building @243736	2015-07-15 13:31:21 (1h 17m ago) SETUP @243731
Talos_PS4_dev	[integration]	odin	2015-06-12 15:24:32 (32d 23h 24m ago) DONE @237103	N/A
dev_Sam3_PC	Dev-Windows	builder11	2015-07-15 07:20:18 (7h 28m ago) DONE @232992	2015-07-15 07:20:18 (7h 28m ago) SETUP @232992
dev_Sam3_PC	SeriousSam3-Windows-Final	builder09	2015-07-15 06:08:15 (8h 41m ago) DONE @232992	2015-07-15 06:08:15 (8h 41m ago) SETUP @232992
dev_Sam3_PC	SeriousSam3_Executables-Linux-Final	builder02	2015-07-15 03:42:57 (11h 6m ago) DONE @232992	2015-07-15 03:42:57 (11h 6m ago) SETUP @232992
dev_Sam3_PC	SeriousSam3_Executables-OSX-Final	builderm01.croteam	2015-07-15 04:15:13 (10h 34m ago) DONE @232992	2015-07-15 04:15:13 (10h 34m ago) SETUP @232992
distro_Sam3_PC	SeriousSam3-Windows-Final	builder09	2015-07-15 02:04:36 (12h 44m ago) building @233112	2015-07-14 04:51:57 (1d 9h 57m ago) SETUP @233112
distro_Sam3_PC	SeriousSam3_Executables-Linux-Final	builder02	2015-07-15 04:12:54 (10h 36m ago) DONE @233112	2015-07-15 04:12:54 (10h 36m ago) SETUP @233112
distro_Sam3_PC	SeriousSam3_Executables-OSX-Final	builderm01.croteam	2015-07-15 03:37:21 (11h 11m ago) DONE @233112	2015-07-15 03:37:21 (11h 11m ago) SETUP @233112
dev_Sam3_Xenon	SeriousSam3-Xenon	builder07	2015-07-15 01:31:01 (13h 18m ago) DONE @210160	2015-07-15 01:31:01 (13h 18m ago) SETUP @210160
distro_Sam3_Xenon	SeriousSam3-Xenon	builder10	2015-07-15 06:08:11 (8h 41m ago) DONE @210165	2015-07-15 06:08:11 (8h 41m ago) SETUP @210165

Legend:
done
building, pre
building, pre
failed, bugx
building
failed, bugx
failed or blo

building @244531	2015-07-28 10:34:48 (3m ago)	SETUP @244527
DONE @244527	2015-07-28 10:25:04 (13m ago)	SETUP @244527
building @244531	2015-07-28 10:23:36 (14m ago)	SETUP @244527

18m ago) DONE

7m ago) FAILED

1m ago) DONE @

- FIX ASAP!!!

- FIX ASAP!!!

19m ago) DONE @

ago) DONE @2

ago) DONE @22

ago) DONE @24

ago) DONE @24

13m ago) DONE

ago) DONE @24

ago) DONE @24

ago) DONE @24

ago) DONE @24

ago) DONE @23

ago) DONE @23

ago) FAILED @

- FIX ASAP!!!

ago) DONE @21

- FIX ASAP!!!

ago) DONE @243217

DONE @244530

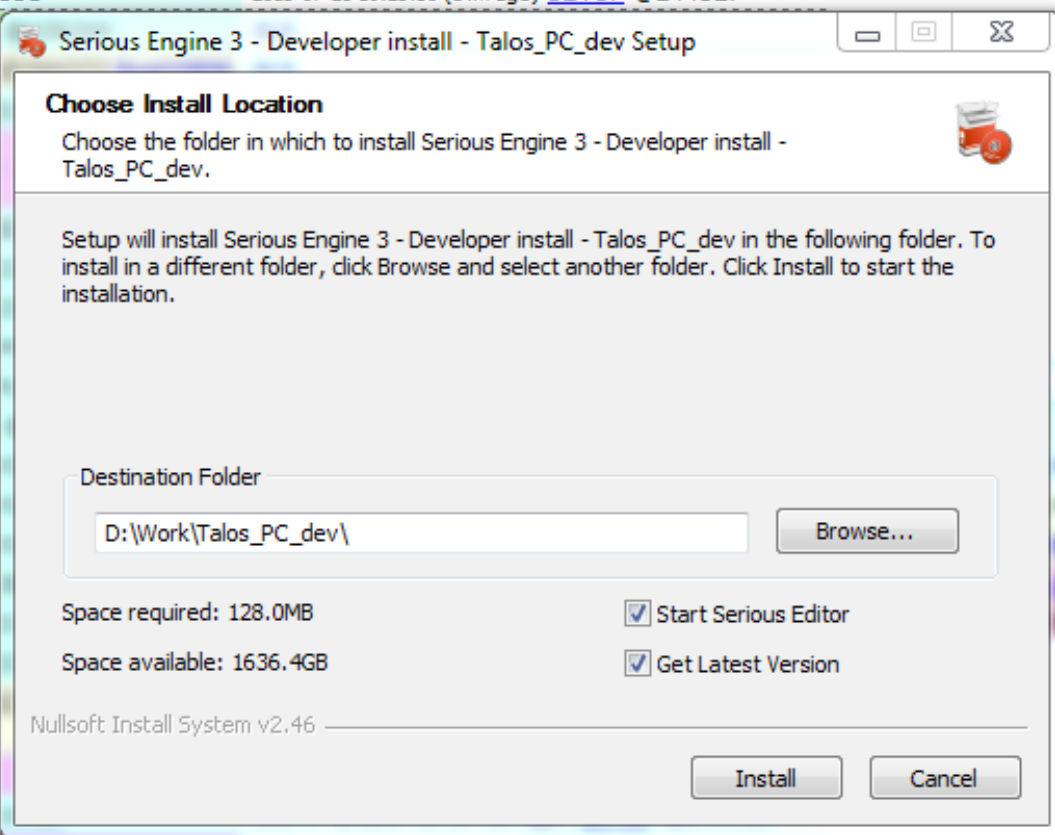
building @244531

N/A

2015-07-28 01:15:21 (9h 22m ago) [SETUP](#) @243217

2015-07-28 10:28:05 (10m ago) [SETUP](#) @244530

N/A



previous build passed

previous build failed

XYZ fixed, not yet st

XYZ assigned, not ye

locked





Content Editor

- central hub for 90% of editing needs
 - in-place editing of meshes, shaders, animations, scripts...
 - in-editor play-testing
- drastically shortens content iteration time
- still using external programs for character animation, texture editing etc.





GPU-based GI solver

- GI ray-tracing – using GPU for processing
- Instead of hours, light baking takes minutes
- Runs on separate “baker” machines
 - Developer can work on something else meanwhile
 - Only need a few super-beefy GPUs
- Implementing this one actually *is* a bit involved
 - perhaps in another talk



5 minutes later...



Talos_Android_dev	Talos-Android-Final	builder02	2015-07-15 06:38:01 (8h 11m ago) DONE @242701	2015-07-15 06:38:01 (8h 11m ago) SETUP @242701
Talos_Android_dev	[integration]	odin	2015-05-26 13:51:28 (50d 0h 57m ago) DONE @231761	N/A
Talos_Android_distro	Talos-Android-Final	builder14	2015-07-15 05:46:16 (9h 2m ago) DONE @237086	2015-07-15 05:46:16 (9h 2m ago) SETUP @237086
Talos_Android_distro	[integration]	odin	2015-05-26 14:01:42 (50d 0h 47m ago) DONE @231826	N/A
AutoTest	Talos_PC_dev-Talos-Windows-Final	tester01	2015-07-15 14:38:02 (11m ago) testing @243742	2015-07-15 14:04:21 (44m ago) NO SETUP @243734
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Talos_PC_dev	Talos-PS4	builder03	2015-07-15 14:45:35 (3m ago) building @243742	2015-07-15 14:43:00 (6m ago) SETUP @243734
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Talos_PC_dev	Talos_Executables-OSX-Final	builderm01.croteam	2015-07-15 14:02:50 (46m ago) DONE @243742	2015-07-15 14:02:50 (46m ago) SETUP @243742
Talos_PC_dev	[integration]	odin	2015-06-11 17:19:23 (33d 21h 29m ago) DONE @236344	N/A
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Talos_PC_distro	Talos_Executables-Linux-Final	builderl02	2015-07-14 15:44:03 (23h 5m ago) DONE @243663	2015-07-14 15:44:03 (23h 5m ago) SETUP @243663
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Talos_PC_distro	[integration]	odin	2015-06-15 10:18:35 (30d 4h 30m ago) DONE @232862	N/A
Sam3_PS3_dev	Dev-Windows	builder12	2015-07-15 00:10:55 (14h 38m ago) DONE @222698	2015-07-15 00:10:55 (14h 38m ago) SETUP @222698
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Talos_PS4_dev	Dev-Windows	builder01	2015-07-15 12:51:57 (1h 57m ago) DONE @243736	2015-07-15 12:51:57 (1h 57m ago) SETUP @243736
Talos_PS4_dev	Talos-PS4	builder04	2015-07-15 13:32:51 (1h 16m ago) building @243736	2015-07-15 13:31:21 (1h 17m ago) SETUP @243731
Talos_PS4_dev	[integration]	odin	2015-06-12 15:24:32 (32d 23h 24m ago) DONE @237103	N/A
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dev_Sam3_PC	SeriousSam3_Executables-OSX-Final	builderm01.croteam	2015-07-15 04:15:13 (10h 34m ago) DONE @232992	2015-07-15 04:15:13 (10h 34m ago) SETUP @232992
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distro_Sam3_PC	SeriousSam3_Executables-Linux-Final	builderl02	2015-07-15 04:12:54 (10h 36m ago) DONE @233112	2015-07-15 04:12:54 (10h 36m ago) SETUP @233112
distro_Sam3_PC	SeriousSam3_Executables-OSX-Final	builderm01.croteam	2015-07-15 03:37:21 (11h 11m ago) DONE @233112	2015-07-15 03:37:21 (11h 11m ago) SETUP @233112
dev_Sam3_Xenon	SeriousSam3-Xenon	builder07	2015-07-15 01:31:01 (13h 18m ago) DONE @210160	2015-07-15 01:31:01 (13h 18m ago) SETUP @210160
distro_Sam3_Xenon	SeriousSam3-Xenon	builder10	2015-07-15 06:08:11 (8h 41m ago) DONE @210165	2015-07-15 06:08:11 (8h 41m ago) SETUP @210165

Legend:

done
building, pre
building, pre
failed, [bugx](#)
building
failed, [bugx](#)
failed or blo



Automated Testing

- Bot can play the game start-to-end
- Can't prove that there are no bugs
- Can prove that the game can be completed
- But wait – it gets even better...





Super-fast Automated Testing

- Human tester needs 10 hours
- Bot does it in 4 hours of game time
- FFWD mode – completed in 20 minutes
- Submit-to-tested **<1 hour!**
- equivalent of >15,000 hours of human testing total – about 8 years of full day testing



Resolving the conflicting goals

- This wasn't implemented in one go
- Long chain of gradual improvements
 - avoid doing a lot at once
 - each small step must do something useful
 - carry over between projects



Rationale

- Long term savings in time
- Menial tasks should be done by machines
 - repeatability
 - avoids human errors
 - avoids frustration \Rightarrow happy developers
 - humans concentrate on design and decisions
- Always more to do



Thanks!

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<http://talosprinciple.com>

<http://www.croteam.com>