

Past, Present, and Future of “Toolsmiths” in Japanese Animation

Jun Kato (Arch Inc.)

in collaboration with Yuki Koyama (Graphinica Inc.), Tatsuo Yotsukura (OLM Digital, Inc.), and Koya Imamura (Toei Animation Co., Ltd.)

SAS 2022 (Animation Unlocked),
Hybrid (Middlesbrough, UK & Online), June 29





Introduction

Past, Present, and Future of “Toolsmiths” in Japanese Animation

Who are we?



Jun Kato,

Arch Inc. (Technical Advisor) / AIST (Senior Researcher)



Yuki Koyama,

Graphinica Inc. (Research Scientist) / AIST (Researcher)



Tatsuo Yotsukura,

OLM Digital, Inc. (Head of R&D Division)



Koya Imamura,

TOEI ANIMATION Co., Ltd. (General Manager of R&D Section)



Past, Present, and Future of Storyboarding in Japanese Animation

Jun Kato, Ryotaro Mihara, Nao Hirasawa (Arch Inc.)

SAS 2021 (Animated Energies), Online, June 15

Our research question

Many studies of animation begin with a question about the object—**what is anime?**—but I suggest a different entry point: **Who makes anime?**

Ian Condry, “The Soul of Anime,” p.3

We pose yet another entry point—our research began with understanding our role as “toolsmiths” for creators and its potential for helping produce good anime, which can be summarized as: **how to make anime?**

Toolsmiths?

tist designs only the abstract properties—its architecture and implementation. Electrical, mechanical, and refrigeration engineers design the realization.

In contrast with many engineers who make houses,

and publication properly commands a higher price from the author in page charges than from the reader in subscription fees. So our writings even in their economics resemble garbage, for which the genera-

The scientist *builds in order to study;*
the engineer *studies in order to build.*

cars, medicines, and clothing for human need and enjoyment, we make things that do not themselves directly satisfy human needs, but which others use in making things that enrich human living. In a word, the computer scientist is a *toolsmith*—no more, but no

tor pays the collector.

This deadly trend already curses American mathematics; its cold chill can be felt in computer science. We are succumbing to the occupational illness of teachers diagnosed 2000 years ago by Jesus Christ.

- Fred Brooks. '96. **“The Computer Scientist as Toolsmith II.”** CACM Vol.39 (3), 61-68.
- “The art challenges the technology, and the technology inspires the art.” [John Lasseter, <https://twitter.com/Pixar/status/93002111918415872>]
- “Making animation films is like a fusion of art and technology.” [Kenichi Anjo, from our interview, 2022]

Dawn of computer-aided animation

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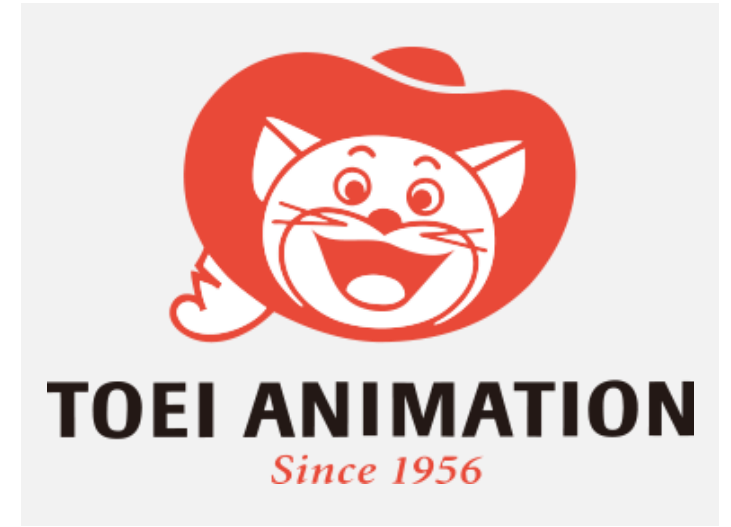
Three case studies in the dawn of computer-aided animation



New York Institute of Technology
Computer Graphics Laboratory



Japan Computer Graphics
Laboratory



Toei Douga Co., Ltd.
(Toei Animation Co., Ltd.)

NYIT example image from <https://blog.siggraph.org/2020/08/pioneering-pixels-the-nyit-computer-graphics-lab-then-and-now.html>

JCGL logo from <https://note.com/nahnah/n/ne7e30432c6fe>

Toei Animation logo from https://corp.toei-anim.co.jp/ja/company/about_pero.html

New York Institute of Technology Computer Graphics Lab (NYIT CGL)



- Founded in 1974, initially led by Edwin Catmull (later hired by Lucasfilm and led a team that became Pixar in 1986)
- **Initial focus: 2D CG animation**
 - Example outcome: Tween (Ed Catmull), Paint (Alvy Ray Smith), and SoftCel (Garland Stern)
- Continuous film and paper publications at **ACM SIGGRAPH** (top-tier academic conference on computer graphics)

My belief was, and still is, that we show all our work and that we publish. It is an illusion to think that we get ahead by holding on to secrets. **The real issue is: How do you attract the best people? You do this by encouraging publishing and open communication in a community.** I have lifelong friends in the SIGGRAPH community. – [Ed Catmull, 2020](#)

Japan Computer Graphics Lab, Inc. (JCGL)



- **The 1st commercial CG studio in Japan**, founded in 1981 and led by Mitsuru Kaneko, faced financial issues and got acquired by Namco Inc. in 1988
- Initial focus: 2D CG animation
 - Imported and adapted NYIT CGL software (e.g., Tween)
 - Collaborated with Agui/Nakajima Lab, Tokyo Institute of Technology
 - Gradually shifted focus to 3D and 2D/3D hybrid animation
- Significant contributions to Japanese CG research/industry
 - Employees/collaborators continued their work
 - Founding member of CG-ARTS (Computer Graphic Arts Society)

Toei Douga Co., Ltd. (Toei Animation Co., Ltd.)



- **The commercial animation studio with the longest history in Japan**, founded as Toei Douga in 1956 (with its former history as Nihon Douga)
- Primary focus: digital transformation of analog workflow
 - Discussed use of NYIT CGL software in late 1970s and gave up
 - Collaborated with Mitsubishi Electric in 1980s and failed
 - Collaborated with Toshiba to design Computer-Aided Toei Animation System (CATAS) in 1985 and implemented it by 1991
- Continuous effort in digitizing/improving production workflow

A very brief summary (1970s—1980s)



NYIT CGL (Lucasfilm, Pixar)

- shifted focus to 3D and marked a major success in a 3D CG film 20 years later
- continuously collaborated with academic researchers



JCGL

- innovated the field in Japan but suffered from rapidly deprecating hardware
- collaborated with domestic researchers



Toei Animation Co., Ltd.

- iterated cost-benefit analysis and investment on digital production workflow
- collaborated with domestic engineering companies

Three case studies, three perspectives

- **Technical issues** in aiding 2D animation production
 - It is ultimately a process of drawing thousands of frames
 - 3D CG has the mathematical representation whose animation can be described as computer programs in a relatively easier manner
- **Overhead costs** of altering existing production workflow
 - Hundreds of people with diverse roles are involved
 - Cost-benefit estimation is always necessary
- Needs for **sustainable R&D**
 - It takes time to recoup the technical investment
 - Toolsmiths respect the community (regardless of their affiliations)

TicTacToon, a tool in France in 1990s (later bought by Toon Boom Technologies)

Why are computer graphics tools so difficult to apply to 2D animation? **It is not enough to simply solve technical problems.** The studio must also be convinced. Today's creation process is essentially a production line, in which a studio of 50 to 300 people work together to produce tens of thousands of drawings for a single feature film or television episode. Everyone has a specified role and follows detailed procedures to move from one stage to the next. Any attempt to computerize the traditional set of tasks must take into account **overhead costs** in both time and quality.

Jean-Daniel Fekete et al., "TicTacToon: A Paperless System for Professional 2D Animation," In Proc. ACM SIGGRAPH '95, 79-90

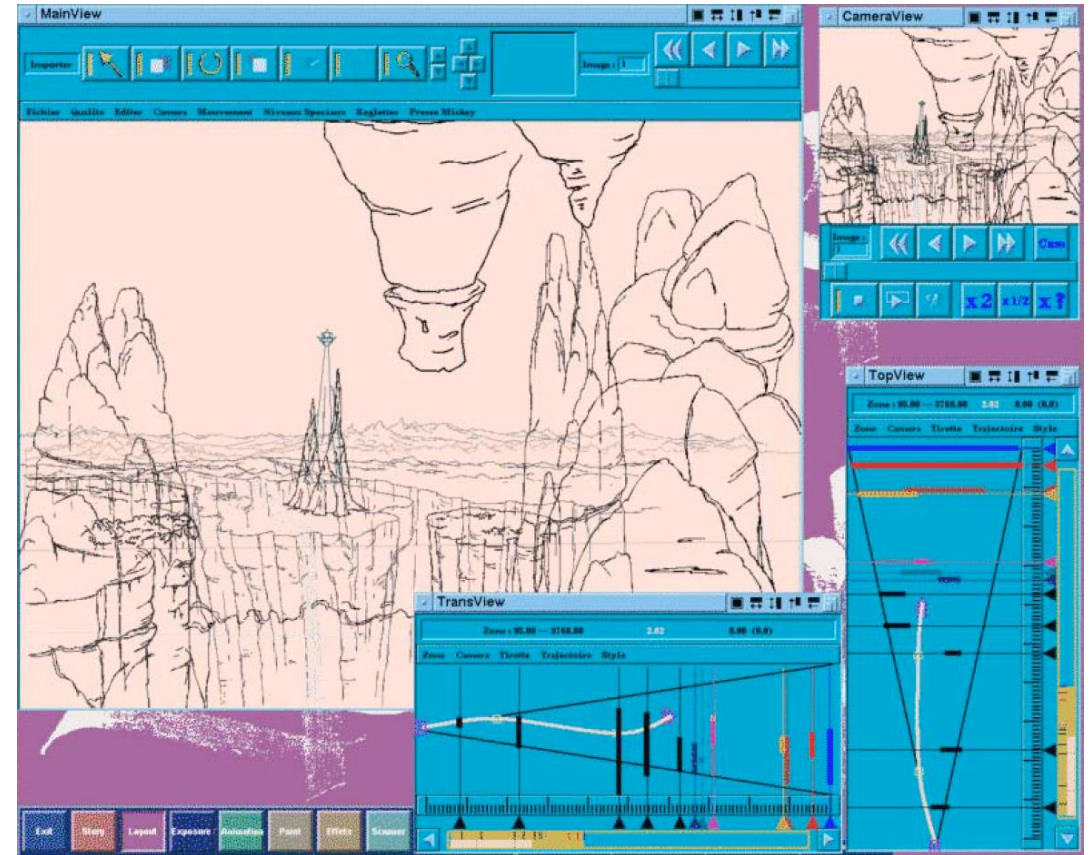


Figure 8: The Layout module showing a front view, top view and side view of a scene.

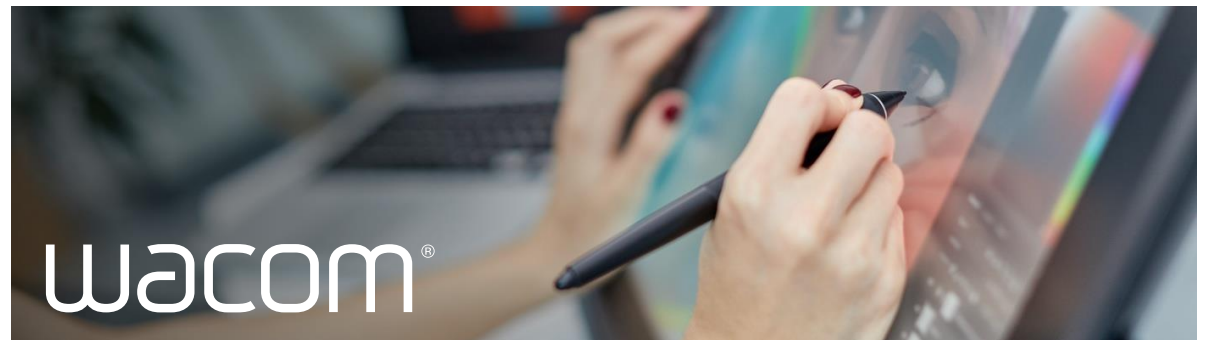
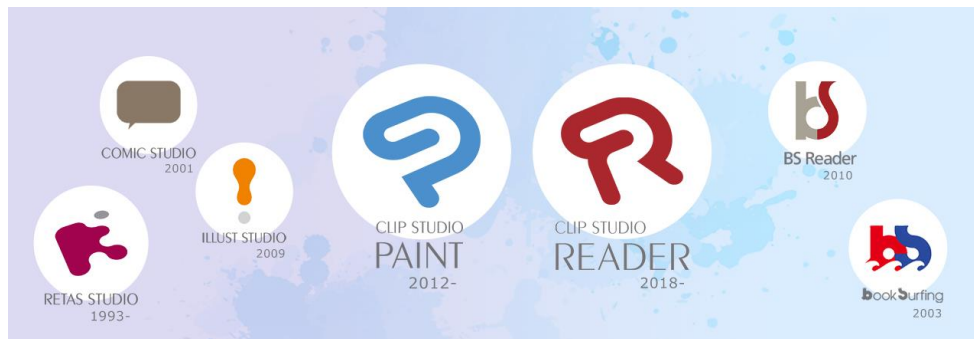


Digitization and beyond

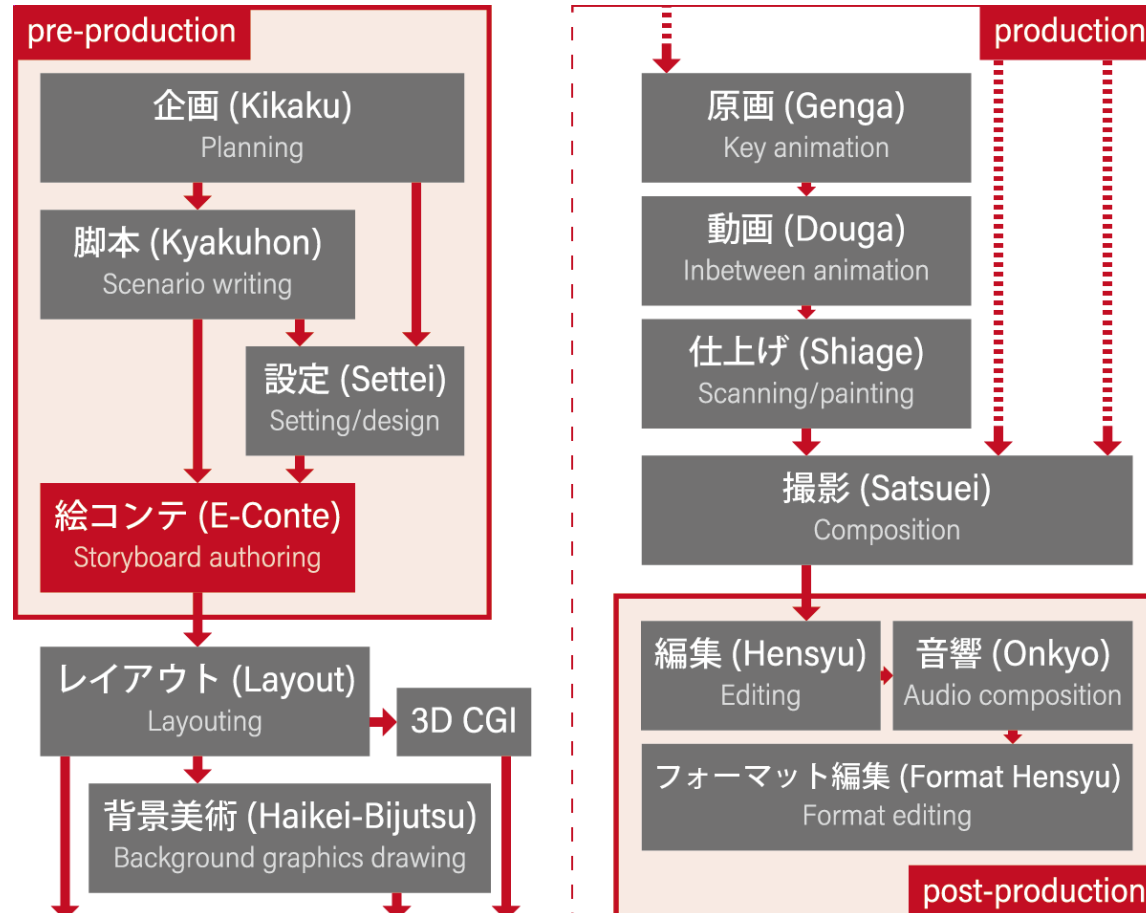
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Toolsmiths in tool vendors

- Anime production has typically been carried out by a group of small companies, making it difficult to invest in R&D
- **Tool vendors have played key roles** in R&D and community management such as CELSYS, Inc. and Wacom Co., Ltd.
- Foreign companies also provided tools for Japanese anime production such as TVPaint, Toon Boom, and CACANi



Current anime production workflow



Most part of the pipeline can already be handled by digital tools:

- Word processors (1980s): scenario
- RETAS STUDIO (1990s-2008): scanning, painting, composition
- CLIP STUDIO, Photoshop, Procreate, etc. (2000s-): scanning, painting
- Adobe AfterEffects, etc. (2010s-): composition
- Stylos (RETAS STUDIO), CLIP STUDIO EX, Toon Boom Harmony, TVPaint Animation, OpenToonz, CACANi, etc. (2010s-): key and inbetween animation

More recent examples of toolsmiths in anime production companies

- OLM Digital Inc.
 - Founded in 1995 as a child company of OLM, hired Kenichi Anjo (former researcher at Hitachi, Ltd.) and started building tools for creators and contributing to the international research community
- Graphinica Inc.
 - Founded in 2009 as a successor of Gonzo digital division, having strengths in 2D/3D hybrid anime production, recently started investment for use of real-time rendering techniques for cel shading anime production
- Project Studio Q, Inc.
 - Founded in 2017 by a joint investment by Khara, Inc., Dwango Co., Ltd., and Aso College Group, investing on IT and education, recently open-sourcing Blender-related tools
- Arch Inc.
 - Founded in 2017 and started its R&D division Arch Research in 2018, building tools for pre-production process such as a digital storyboarding tool

Other production studios with strengths in digital anime production

- Polygon Pictures Inc.
 - Founded in 1983 (the commercial CG studio with the longest history in Japan) and started making TV anime series in 2014 (Knights of Sidonia), known for its thorough production workflow management
- Digital Frontier Inc.
 - Founded in 2000 with strengths in similar domains to Polygon Pictures Inc. (CG/VFX), collaborating with other anime productions
- Orange Co., Ltd.
 - Founded in 2004 with strengths in cel shading animation production, recently starting to advertise their research and development outcome

Local events for artists (and toolsmiths)

- Ani-tsuku (あにつく) since 2015
- Animation Creative Technology Forum since 2015
- CGWORLD Creative Conference since 2011



CGWORLD
クリエイティブ
カンファレンス

Recap of the “past” section – what now?

Three case studies, three perspectives

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9:00-10:30am, Jul. 29 (Wed), 2022

"Toolsmiths" in Japanese Animation (SAS 2022)

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- **Technical issues** are tackled by data-intensive approaches (e.g., deep learning)
- **Overhead cost** is not the major issue any more
- **Sustainable R&D** is always important

A very brief summary (1990s—2010s)

- **Benefits start to win** against costs of digitizing the workflow
 - Cel (celluloid) sheets stopped being produced
 - High-resolution videos had become mandatory for streaming
 - Young creators are used to digital tools and welcome new ones
- **Creative use** of digital tools had enabled production of high-quality anime films, but **creative development** of novel digital tools had still been quite rare
- **Academic research had faced difficulties** contributing to the anime industry because of the technical issues and complex industrial structure

State-of-the-art in R&D for anime production (2020s–)

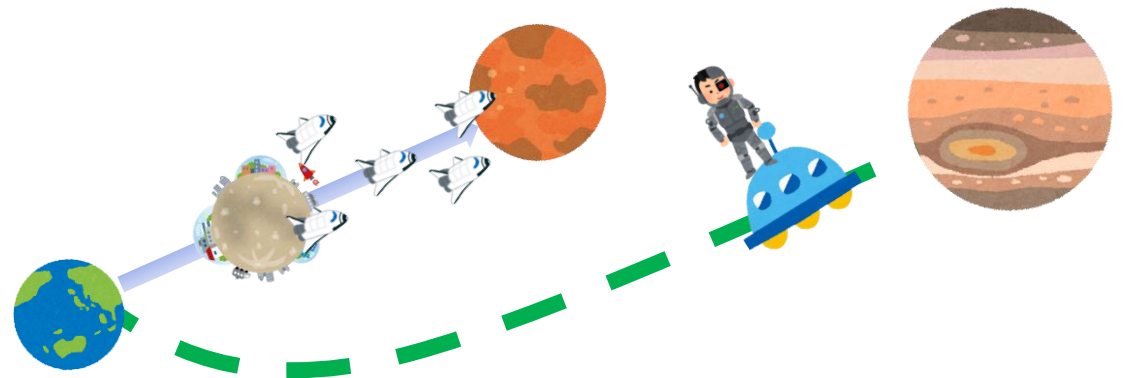
- Experimental animations created by small teams set the bar of the new standards [Kenichi Anjyo and Nao Hirasawa]
 - Past examples: Pixar short films [Computer Animation Festival at SIGGRAPH]
 - Recent domestic examples: music videos
 - “Agile” anime production has become more and more important
- Collaborations beyond each production studio – between academia and industry – are starting to take place
 - Academic conferences have invited technical artists and toolsmiths from the anime production companies [CGVI workshops]
 - Anime production companies have started providing public datasets for academic research [TRIGGER Inc., Arch Inc.]

Related: SIGGRAPH Asia 2021 panel <https://research.archinc.jp/en/events/siggraph-asia-2021/>

Future outlook

- Most part of the pipeline can be **theoretically** handled by digital tools, but it is just the beginning (from Moon to Mars)
- Novel tools have been developed for use in anime production, such as Unity and Blender, enabling an **entirely new** production pipeline (to Saturn!?)

In either way, toolsmiths are exploring the answer to “**what makes a good anime?**” with collaborations with artists...



The figure was originally created by Koya Imamura (TOEI ANIMATION Co., Ltd.) and adapted for use in this talk

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Appendix

Past, Present, and Future of “Toolsmiths” in Japanese Animation






Jun Kato

加藤 淳



@junkato

<https://junkato.jp>

-  **The University of Tokyo** Igarashi Lab '09 BSc, '11 MSc, '14 PhD
-  **Microsoft Research** Asia '12/1-4 Research Intern / **Microsoft Research** '12/6-9 Research Intern
-  **Adobe** Creative Technologies Lab, Seattle '13/8-11 Research Intern
-  **National Institute of Advanced Industrial Science and Technology (AIST)** '14/4- Researcher, '18/10- Senior Researcher
-  **Arch Inc.** '18/7- Technical Advisor, Principal Investigator of Arch Research



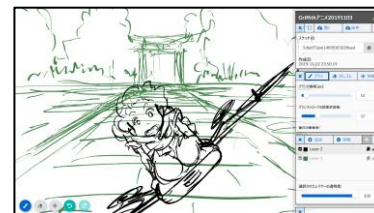
TextAlive
[ACM CHI '15]



Songle Sync
[ACM Multimedia '18]



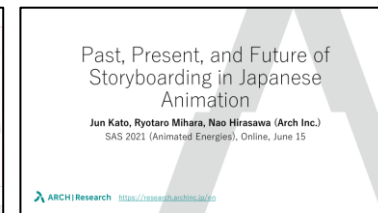
TextAlive for lyric video
Hatsune Miku "Magical Mirai"



Griffith Sketch
[2020]



Griffith
[2020-2022]



Conference talk on Storyboarding
[SAS '21]

Human-Computer Interaction researcher **studying creative activities** e.g., programming, video authoring, storyboarding and **building and deploying creativity support tools**

Hatsune Miku "Magical Mirai" credits: © Crypton Future Media, INC. www.piapro.net / © SEGA, Graphics by SEGA / MARZA ANIMATION PLANET INC., Organized by TOKYO MX / Crypton Future Media, INC.

Our approach

- Literature review
- Expert interviews and self reflections
- Kenichi Anjyo OLM Digital, Inc. (Technical Advisor)
- Nao Hirasawa Graphinica Inc. (CEO), Arch Inc. (CEO)
- Hiroshi Moriguchi Graphinica Inc. (Animation Producer)
- Hiroyasu Kobayashi Project Studio Q, Inc. (CEO)
- (Anonymous) A person working at a famous tool vendor
- Yusuke Matsui The University of Tokyo (Lecturer)
- Four of us working as researchers/managers of R&D teams in the industry