

How a Group of NASA Renegades Transformed Mission Control

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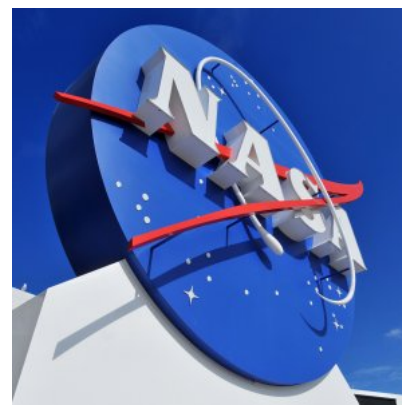
Loizos Heracleous, Christina Wawarta, Steven Gonzalez, and Sotirios Paroutis

Rebels create novel solutions, revitalize innovation, and can future-proof your business.

In business, we often label renegades and rebels as troublemakers — individuals who have to “get with the program” to align the organization both internally and externally. Our research at NASA, however, suggests we need renegades more than we think. Far from being obstacles to the work at hand, renegades can offer powerful ways to revitalize and shift organizations into the future.

Over time, organizations establish goal-achieving cultures and ways of operating, which often are not conducive to change. Habits, sunk costs, the strength of tradition, politics, and established worldviews all maintain the status quo. But as the competitive environment changes and unexpected challenges emerge, businesses need to adapt their approach.

The nudge organizations need to push in a different direction often comes from renegade groups — those that spot looming challenges and envision potential solutions outside the organization’s current ways. These groups are committed to elevating business capabilities and future-proofing them for novel challenges, often despite opposition from the status



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quo. It is therefore essential for organizations to create a climate that fosters rebel thinking and supports these contributors within their ranks.

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Balancing Efficiency and Innovation

We conducted case-study research from 2013 through 2018 at NASA's Johnson Space Center to understand how organizations can become *ambidextrous* — which we define as being able to balance competing objectives like efficiency, innovation, and the development of current and future capabilities. Our research involved ethnographic visits, workshops, interviews of managers, engineers, and scientists, and historical document analysis.

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During our research, we became familiar with a highly effective renegade group that would later become known as the “Pirates.” This innovative and agile group formed in 1986 and created an award-winning mission control system for the space shuttle program in record time, on a shoestring budget, and in the face of political resistance. This group's values and methods challenged the established hierarchical culture. They were pioneers in agile practices (<https://sloanreview.mit.edu/article/a-new-approach-to-designing-work/>), even before agility entered the organizational vocabulary or the agile manifesto was created in the software industry. The group was able to overcome opposition, win the support of high-level sponsors within NASA, and eventually develop a new shuttle mission control with huge cost savings. The group's story offers important lessons for all organizations in how renegades can help business balance the often competing goals of efficiency and innovation.

How the Pirates Brought Real-Time Data Systems to Mission Control

When John Muratore, a young engineer, joined the Johnson Space Center in 1983 after four years in the Air Force supporting the space shuttle program, he was surprised to see that the computer architecture in operation in the shuttle mission control center was still the Apollo-era mainframe system. Displays were monochrome, lacked graphics, and the system could handle only a limited number of simultaneous

calculations. Any changes in functionality could take months to implement. He wondered whether the incumbent mainframe system could stand up to the burgeoning complexity of the shuttle program and the planned International Space Station.

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Muratore connected with a small group of newly recruited engineers who felt the same way about the incumbent system. They wanted to future-proof mission control by using an open, distributed, upgradable, and scalable systems architecture built to incorporate not-yet-invented technologies.

The group's concerns initially fell on deaf ears. Mission control was confident in the tried-and-tested incumbent system — after all, it had taken humans to the moon, and flight controllers and software engineers knew its quirks and could respond in any emergency.

The group was undeterred. As we'll explore below, the secret of their success was their approach: They won out by achieving results, showing resilience in the face of challenge, and maintaining personal responsibility.

Challenging the Status Quo

By taking action that challenged the established culture of their organization, the Pirates innovated new mission control capabilities for NASA, resulting in the group's first project, Real-Time Data Systems (RTDS), which took a year's worth of off-hours time to create.

This system, composed of clusters of off-the-shelf hardware and tailor-made code, was built with funds from a small internal grant for “new technology.” They even borrowed hardware that they could keep for only 90- to 120-day cycles, given government rules about [using free resources from NASA suppliers](https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/SSP/Muratore14-08.htm) (https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/SSP/Muratore14-08.htm). Eventually RTDS was brought into mission control, and our research showed support from a high-level sponsor — in this case, flight director Eugene Kranz — was a key factor in renegade success.

Their new system displayed color graphics and user-friendly interfaces, integrated reports on the status of shuttle systems, and ran seamlessly on occasions when the mainframe system crashed. Flight controllers realized they could make decisions faster and more accurately with the new system. All the technical systems required to fly the space shuttle were then gradually [transitioned to the renegades' system](http://science.sciencemag.org/content/244/4908/1044) (<http://science.sciencemag.org/content/244/4908/1044>).

The Pirate Paradigm: Agility Before It Was in Vogue

Because of the success of RTDS, Muratore was asked to pull together a team to upgrade the entire mission control system for the planned International Space Station. This new group created the “Pirate Paradigm” — values that challenged the established culture, and some of which echo modern agile principles:

- Don't wait to be told to do something; figure it out for yourself.

- Challenge everything, and steel yourself for the inevitable cynicism, opposition, rumors, false reporting, innuendos, and slander.
- Break the rules, not the law.
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- Take risks as a rule, not as the exception.
- Cut out unnecessary timelines, schedules, processes, reviews, and bureaucracy.
- Just get started; fix problems as you go along.
- Build a product, not an organization; outsource as much as possible.

By shaping action that went beyond the established conservative culture, their values allowed innovation of essential mission control capabilities for NASA. The Pirates' motto was "build a little, test a little, fix a little," and their practices included:

- Regular short-cycle milestones to encourage continuous improvement and experimentation.
- Results orientation.
- Cutting out bureaucracy.
- Encouraging personal accountability and responsibility.
- Challenging convention, while operating in a large, rule-bound hierarchical organization.

It takes great persistence and commitment for innovators like the Pirates to challenge an organization's culture, but as their success with the shuttle program and International Space Station shows, that is often what organizations need most.

Renegades Revitalize: Novel Challenges Need Novel Problem Solver

All systems and organizations have performance limits that may make them unable to deal with novel challenges. Companies often resist new approaches in favor of the established order and dominant interests, and organizational inertia discourages proactive innovation.

The NASA Pirates were faced with legacy mainframe computing that could not deliver the functionality and flexibility of distributed computing. A parallel can be seen in today's financial services, health care, automotive, retail, and education sectors, which are all just beginning to see the reshaping potential of

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artificial intelligence (AI) (<https://sloanreview.mit.edu/projects/artificial-intelligence-in-business-gets-real/>). Organizations need new information technologies and organizational processes, not just refining of current systems, to capitalize on AI's potential benefits.

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This is where “positive deviants” (<https://hbr.org/product/the-power-of-positive-deviance-how-unlikely-innovators-solve-the-worlds-toughest-problems/1066-HBK-ENG>) such as NASA's Pirates come in. These individuals and groups are embedded in operations, understand looming challenges, and have the expertise, motivation, and vision to seek and create better ways to deal with these challenges. They are the “troublemakers,” as some wedded to the status quo see them, who can end up bringing essential competencies to the organization.

Nurture Your Rebels: Create Fertile Ground for Innovation

Many organizations focus on strategic and organizational alignment, expecting everyone to toe the line and pouncing on any signs of deviation from the norm. Homogeneity can foster efficiency and optimization, but also has the inherent risks of not allowing system evolution (or revolution for that matter). An important antidote to inertia is renegade groups, positive deviants who, via constructive dissent and innovative outputs, may hold the key to improvements in technology and human systems

(<https://sloanreview.mit.edu/article/digital-disruption-is-a-people-problem/>). Organizations can foster renegade groups by creating fertile ground for such groups to emerge:

- Develop an organizational culture truly open to challenge and positive dissent.
- Provide positive deviants with seed funding and time for experimentation.
- Shelter renegade groups from company bureaucracy and politics once they emerge.
- Ensure that high-level sponsors connect with and support these groups.
- Recognize early wins of renegades to motivate the organization to adopt new practices.
- Develop leaders with ambidextrous mindsets — balancing the needs of present and future; optimization and creation.

Creating this kind of environment can amplify positive deviance rather than suppress it and offers the best chance for renegade groups to appear and make a positive difference.

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Even today, the NASA Pirates' methods are innovative for many organizations, and they were nothing short of revolutionary in NASA's procedural, rule-bound, hierarchical organization. Their approach was seen as an intrusion that angered many who wanted to see them fail. There was fierce opposition from the established order, including middle management and software developers who felt the flight-operator Pirates, by writing their own code, were encroaching on their turf

(<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19920002801.pdf>). But, as the group won quiet support of high-level sponsors, their advancements and innovation brought support and ushered in organizational transformation.

The history of renegade groups shows that changes occasioned by such groups are not just cosmetic or superficial. Transformational changes can be achieved because renegades challenge the status quo with credible solutions and because these innovators have intrinsic motivation to make a difference. This motivation is a key way of determining if renegades in your organization are constructive, positive deviants, or just anarchists. Protection and support from high-level sponsors, who understand the value of the quest for new ways, offer advice and strategic perspective, and can step in to remove obstacles from the renegades' path, is often key to their success.

The NASA Pirates' vision of the Mission Control Center was deployed in 1996, but their effects reverberate today. They took their methods with them across the organization; several former Pirates are now leaders across the agency and the space industry. The history of other renegade groups, such as Lockheed Martin's fabled Skunk Works (<https://www.amazon.com/Skunk-Works-Personal-Memoir-Lockheed/dp/0316743003>) and Steve Jobs' Macintosh project (<https://www.amazon.com/Leading-Apple-Steve-Jobs-Controversial/dp/1118379527>) shows that this is not a unique, parochial case. Fostering such groups in your organization or company could shift the balance from inertia and decline to innovation and competitive advantage.

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