An Actor-Network Theory Analysis of the Unsuccessful Robotic Hysterectomy of Laurie Featherstone

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

In January 2015, Laurie Featherstone visited a gynecologist with complaints of a uterus growth and an irregular menstrual cycle. During her sub-ten-minute appointment, the doctor recommended surgery as a next step, saying "If I were you, I'd choose a hysterectomy, and I'd elect the robot. Less down time, little scarring, and less than a 3% complication rate" (Featherstone, 2017, para. 1). On the night of the surgery, she received a call that the original surgeon was no longer with the group, but another surgeon with more experience wanted to continue with the operation. Featherstone took their advice and chose to have a complete hysterectomy with the da Vinci Surgical System (dVSS), without knowing that robotic hysterectomies have relatively high rates of serious complications; in one study published in 2015, the complication rate was 18% (Featherstone, 2017; Marrs, 2022).

Unfortunately, Featherstone encountered numerous complications related to her ureter, bladder, nerves, right diaphragm, pelvic wall, and colon, many of which she is still battling (Featherstone, 2017). Scholars have previously investigated technical aspects of robot failure and financial factors that can lead to adverse events during robotic surgery in general (Alemzadeh et al., 2016; Wilensky, 2016). However, scholars have not sufficiently analyzed social factors such as poor team dynamics, lack of quality treatment, and legal limitations regarding surgical training that played a role in provoking complications specific to Featherstone's hysterectomy. If we attribute the failure of the hysterectomy only to the current factors considered within general robotic surgery, then we will not have a more comprehensive account of the range of contributing factors to this case.

In this STS research paper, I argue that the unstable team dynamics, lack of quality care, and legal restrictions had a major impact on the negative outcomes of Featherstone's surgery, in

addition to any technical defects and financial motivations on the part of the surgeon. To make this argument, I will apply Actor-Network Theory (ANT), a conceptual framework that considers how human and non-human components serve as actors within a heterogeneous network. These actors constantly define and redefine a sociotechnical arena by combining together to impact technology through a process of technical development called translation (Cressman, 2009). In my argument, I will identify the actors and associations within the actor-network and use ANT to analyze the weak links. To support my claim, I will examine evidence from primary and secondary sources, such as Featherstone's personal documentation about her experience and news coverage, which will shed insight on how the stated social factors affected Featherstone's post-operative complications.

Literature Review

While several scholars have examined operational practices and external influences that lead to adverse events during robotic surgery in general, scholars have not yet adequately considered social factors that specifically contributed to the series of complications following the robotic hysterectomy of Laurie Featherstone. Previous scholarly analyses typically focus on technical flaws and financial aspects as drawbacks associated with robotic surgery. These components could have been partly responsible for the ramifications following Featherstone's hysterectomy, but they do not cover the disappointing social facets that cemented the failure of the surgery.

Alemzadeh et al. (2016) developed an automated natural language processing tool to analyze unfavorable incidents from 2000 to 2013 related to robotic surgical systems documented in a publicly available database maintained by the U.S. Food and Drug Administration (FDA). They extracted information regarding patient injury, surgical specialty, type of robotic procedure,

major types of device or instrument failures, and adverse events that interrupted the progress of surgery, totaling 10,624 events. The researchers found that the most common shortcomings related to unsuccessful surgeries are inadequate experience with managing emergencies, troubleshooting technical issues, checking the system/instrument before the procedure, manipulating robot master controls, coordinating between hand and foot movements, using robot-specific features, and setup of electrical parts. While the study goes in depth to show how these technical difficulties associated with robotic surgery are not negligible, it does not analyze social aspects that can cause complications due to the absence of this information in the database (Alemzadeh et al., 2016).

Wilensky (2016) sheds light on a different aspect of robotic surgery: cost. Procedures using the dVSS can cost $3,000 to $6,000 more than traditional laparoscopic surgeries. This significantly higher cost can be attributed to the hospital needing to offset the $2 million minimum cost of purchasing each surgical system and insurance companies not reimbursing the higher charges for patients. While some procedures benefit from robotic over traditional surgery, others do not. For example, robotic surgery does not improve outcomes noticeably for gynecologic surgeries, including hysterectomies, the second most common surgery for women and the procedure that Featherstone underwent. Instead, the robotic hysterectomies studied simply took longer and incurred an extra $2,000 to the procedure. Even worse, many hospitals are advertising that they can perform robotic surgery as a way to stand out from other hospitals in the area, encouraging the use of robotic surgery as a reputation boost (Wilensky, 2016). This article exposes the economic implications that can encourage surgeons to perform unjustified robotic surgeries, but again does not examine social factors that can lead to avoidable complications with robotic surgery, much less social factors specific to the Featherstone case.

While there exists a substantial amount of research regarding how technical and economic factors affect robotic surgeries, it is also important to consider how social aspects can impact robotic surgeries, which we can learn about through specific case studies. In particular, within the current body of research, there is an inadequate amount of investigation into the failed robotic hysterectomy of Featherstone. Thus, this paper will use ANT to address shortcomings in the scholarship regarding the influence of social factors on Featherstone's unsuccessful hysterectomy, which will advance understanding of the sociotechnical factors that affect robotic surgery in general.

Conceptual Framework

My analysis of the failed robotic hysterectomy of Laurie Featherstone draws on ANT, a conceptual framework that evaluates the human and non-human elements that function as actors within a network. In this framework, an actor is defined as anything that is a source of action, whether social, natural, economic, or technical. The identity of these actors is shaped through their interaction with other actors within a network described as "sociotechnical" or "heterogeneous" to emphasize the equal consideration of humans and non-humans. ANT explores the associations or connections between actors, examining how these attempted associations either fail or succeed. The strength of associations determines the size, influence, durability, and power of networks. Thus, an actor-network is the result of the connections of which it is comprised (Cressman, 2009).

ANT deconstructs the "black box" of the network by tracing the intricate relationships that exist among the various actors. A network builder (NB), or primary actor, assembles this heterogeneous network of actors to accomplish a goal by realigning their interests to serve those of the network. This process of constructing and maintaining a network, including establishing

connections among actors and the general movement of technological development that occurs over time, is known as translation (Cressman, 2009). Callon (1986) defines four "moments" or stages of translation: problematization, interessement, enrolment, and mobilisation. In problematization, the NBs define the problem, identify the actors required to solve it, and define the roles and associations of the actors. The NBs also establish themselves as the indispensable central node in the network by identifying how the actors will move through the "obligatory passage point," a channel that shapes the interests of the actors to support the goal of the network. The interessement stage puts the plans from problematization into action. The NBs try to recruit other actors into the network by removing them from competing networks and aligning their interests those of the network. Then, in enrolment, the actors accept and carry out their roles as assigned. Finally, in the mobilisation stage, the NBs take on their role of representing and speaking for the other actors and mobilize them to act (Callon, 1986).

By mapping how NBs define and assign roles and mobilize other actors to perform these roles, ANT provides a research framework that describes how and why technologies are formed. It also reveals complexities and possibilities that might otherwise be overlooked (Cressman, 2009). Drawing on ANT, I begin my analysis below by constructing the network through the identification of the various actors involved in the robotic hysterectomy. Then, I analyze the associations among these actors, using Callon's (1986) concept of translation to pinpoint weak points in the connections that destabilized the network as a whole and led to post-operative complications.

Analysis

Actor-Network Reconstruction

Reconstruction of the actor-network revolving around the robotic hysterectomy of Laurie Featherstone will provide the necessary structure for the ANT analysis to follow. The first step in reconstruction is to identify the heterogeneous actors in the network. These actors are defined as follows: (1) the surgical department chairman, who oversees the clinical divisions, interacts with other department chairs and hospital administrators, and manages operations and finance; (2) Intuitive Surgical, the manufacturer of the dVSS; (3) the FDA; (4) the hospital credentialing committee; (5) the dVSS used in the operation; (6) the surgeon performing the hysterectomy; (7) the support team, consisting of operating room (OR) staff, nurses, and other employees critical to the operation; (8) the urologist performing the post-operative ureter procedure; and (9) the patient, Laurie Featherstone (Featherstone, 2017; Maykel, 2013; Siegel et al., 2018).

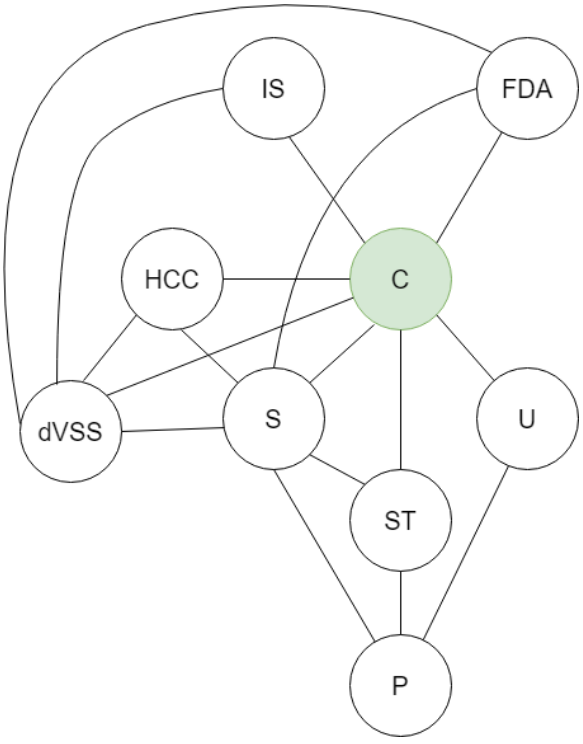
In order to understand the social factors at play within the network, it is essential to recognize how the heterogeneous actors are connected to one another. I will draw these associations by following the formation of the network through Callon's (1986) stages of translation. In this case, the NB who recruited the actors into the network is the surgical department chairman. The chairman communicates with both actors outside of the hospital, such as Intuitive Surgical and the FDA, as well as actors working within the hospital, such as the surgeons and patient, so I assign the chairman as the central node in the system (Maykel, 2013). While there may be other people involved in the communication channel between the chairman and doctors, those extraneous actors are disregarded in this network for simplicity to keep all actors directly relevant to the Featherstone case.

The ideal form of the Featherstone actor-network is shown in Figure 1, where all associations are strong and presented as bold lines between the actors within the network, which are represented as labeled circles. The NB, or the surgical department chairman, is shown in

green in the center of the diagram as it is the primary actor. During the first stage of problematization, the chairman determines that a medical team needs to address the issues faced by a new patient, Laurie Featherstone. The chairman identifies Intuitive Surgical as the company that can provide the dVSS, the FDA as an overarching source of authority to ensure that complications are minimized, and the hospital credentialing committee to ensure the smooth onboarding of the dVSS into the network. The chairman also identifies the necessary people needed to carry out the hysterectomy on the patient – that is, the surgeon, support team, and post-operative staff, such as the urologist in this case (Siegel et al., 2018). Thus, the chairman constructs the network by connecting the various actors to one another by shaping their interests through the "obligatory passage point" so that all actors are working towards the same goal of carrying out a successful hysterectomy for Featherstone.

Figure 1

Ideal Actor-Network Diagram for the Featherstone Case



Note. C is the surgical department chairman, IS is Intuitive Surgical, FDA is the U.S. Food and Drug Administration, HCC is the hospital credentialing committee, dVSS is the da Vinci Surgical System, S is the surgeon conducting the hysterectomy, ST is the support team, U is the urologist, and P is the patient.

During interessement, the chairman successfully recruits the other actors to participate in the network and induces these actors to adopt the chairman's problem definition and solution of aiming to complete a hysterectomy without complications for Featherstone. The chairman recruits Intuitive Surgical, the FDA, and the hospital credentialing committee into the network to prepare for the robotic hysterectomy. Then, the chairman hires the surgeon, support team, and urologist to take care of the hands-on aspects of the surgery (Siegel et al., 2018).

In enrolment, all of the recruited actors would ideally accept and perform their assigned roles and forge the strong associations illustrated in Figure 1. Assuming that a successful actor-network holds, Intuitive Surgical would ship the requested dVSS to the hospital, where the hospital credentialing committee would sign off on the use of the robotic system only by surgeons who are qualified to use it. Ideally, the chairman would also be in contact with the FDA to enforce proper training and education among surgeons using the dVSS before the hospital credentialing committee certifies them. The surgeon would perform a successful hysterectomy with no complications by valuing the care of the patient above all else and working well with the support team. The urologist would not need to perform a post-operative procedure as Featherstone's ureter would be functioning perfectly, and Featherstone would leave the hospital with her uterus successfully removed and no other organs damaged (Siegel et al., 2018). In the final translation stage of mobilisation, the chairman would be able to declare that a hysterectomy using the robotic surgical system was successful and encourage the use of the dVSS in the future.

Poor Team Dynamics

One of the social factors that led to post-operative complications for Featherstone was the poor group dynamic between the surgeon, support team, and surgical department chair, together comprising the surgical group assigned to Featherstone's hysterectomy. In Featherstone's (2017) article documenting her personal experience, she wrote "I received a call night of surgery explaining my original surgeon was no longer with the group, but this alternate one was a group partner, and had more experience and wanted to proceed." This quote indicates that the original surgeon could not perform the operation as he "was no longer with the group," rather than simply having a scheduling conflict (Featherstone, 2017, para. 2). Not only does this insinuate that there is contention within the team, but this disharmony is underscored by the abruptness in the change in surgeon. Featherstone did not receive notification that the original surgeon left until the "night of surgery," indicating that the conflict that occurred must have been severe enough that the surgeon would not even stay a few more hours to complete an important scheduled surgery (Featherstone, 2017, para. 2).

According to Marcus Heneen, a design director at McKinsey Design who specializes in human-robot interaction, surgery does not just involve the mechanical tasks of handling instruments and suturing; it is also a "collaborative process between surgeons and their teams with a strong social component to it" (McKinsey & Company, 2020). The sudden departure of the original surgeon already suggests that communication between the surgeon, the team, and the chairman is damaged, and replacing the surgeon with a new person only mildly associated with the group just hours before Featherstone's hysterectomy does not immediately create a healthy dynamic, as the team is not familiar with the new surgeon. In the highly interdependent and demanding OR, the hysterectomy would have been a trial in collaboration, resulting in a less-

than-ideal situation for the surgery. Without a harmonious team dynamic, it is easier for complications to occur, as a well-functioning team is essential to realizing quality care and patient safety (Tørring et al., 2019).

Even outside of the OR, it is evident that the communication within the surgical group is uncoordinated. After the hysterectomy, the surgeon ordered a bladder scan for Featherstone, but no one completed the scan for her, worsening the complications with her ureter (Featherstone, 2017). This further demonstrates that the team lacks organization and enough respect for other actors to carry out tasks. Thus, the unsatisfactory team dynamic is a social factor that led to post-operative complications, as the actors did not fulfill their assigned roles as cooperative members of a team in the enrolment stage of translation. As a result, the associations among the surgeon, support team, and chairman are weak, illustrated by the dashed red lines connecting these actors in Figure 2.

Lack of Quality Care from the Surgeon

Another social aspect of the actor-network that factored into the severity of Featherstone's complications was the absence of quality treatment from the surgeon. After her hysterectomy, Featherstone complained of acute pain on her right side. Not only did the surgeon brush off this concern, but he then revealed that he encountered difficulty in the pelvic wall on the left side of the patient during the surgery. However, he was not worried because Featherstone did not have complaints regarding her left side at the time. Later, Featherstone found that her pelvic wall was in fact damaged with loss of colon muscle function, and she would need a permanent colostomy in the future (Featherstone, 2017).

After Featherstone was discharged, she "relentlessly called [the surgeon's] office and went in, only to be treated as if [she] was seeking drugs" (Featherstone, 2017, para. 5). After

enduring the pain for a week, Featherstone went in for an emergency room visit to find that her ureter had been burned and she had severe hydronephrosis, the swelling of the kidney due to urine buildup. The surgeon was supposed to perform a dye test following the surgery that could have detected this, but he never ordered it. After three renal stent placements, a urologist had to dissect and reimplant Featherstone's ureter, needing to attach by feel due to the numerous adhesions from the unnecessary robotic surgery (Featherstone, 2017).

There are multiple instances in the interactions between Featherstone and her surgeon described above where the surgeon does not show proper care. First, the surgeon dismisses Featherstone's concerns about the pain on her right side, not utilizing the knowledge and tools at his disposal as a surgeon to investigate further. While Featherstone does not have complaints about her left side at the time of the checkup, issues with that area later arise. Even though the surgeon is aware of operational difficulties with that side, he does not take preventative measures to avert future complications. The surgeon is constantly unavailable through phone calls as Featherstone had to call "relentlessly," and does not take Featherstone seriously when she visits in-person, as she claims to be treated as a "drug" addict (Featherstone, 2017, para. 5). Because of his negligence to perform a dye test after the surgery and to address her concerns, Featherstone suffers from significant ureter complications (Featherstone, 2017). The dereliction of duty by the surgeon plays a role in the number and severity of consequences that Featherstone undergoes; this social aspect is represented in Figure 2 with a dashed blue line for the weak association between the surgeon and patient.

As I have argued, neglect on the part of the surgeon is a contributing social factor to Featherstone's complications due to his dismissal of concerns and disregard towards proper post-operative tests. However, some might believe that the new surgeon is making the best decisions

he can with the information he has at hand, as he has a greater amount of experience compared to the original surgeon (Featherstone, 2017). Perhaps he truly believed the robotic method was necessary and did not believe that additional post-operative tests were needed. This view fails to consider underlying reasons for the surgeon's decisions. The original surgeon is suing the group she was a part of – the same group that managed Featherstone's hysterectomy – for being coerced to handle an overload of patients and generate revenue for the group. Thus, it would not be surprising to find that the new surgeon, who is also a group partner and therefore manages financials for the group, has immoral motivations for his decisions, such as generating a profit based on an increased number of complications (Featherstone, 2017). Consequently, I argue that the poor medical care on behalf of the surgeon is a valid social factor that is responsible for the myriad of complications Featherstone endures.

Lack of Legal Authority over Surgical Readiness

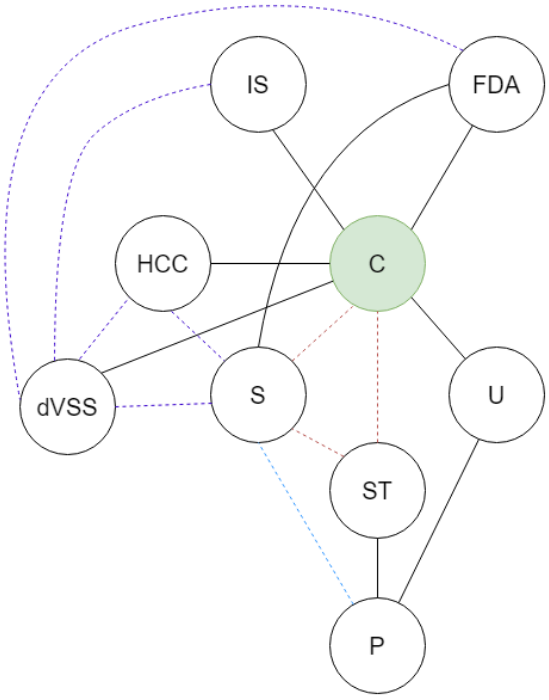
A third social element that added to Featherstone's complications was the legal limitations on the power of the FDA and Intuitive Surgical to manage surgical training. In response to inquiries from NBC News, Intuitive Surgical said that "we are only permitted to train on our technology – we cannot, by law, train on clinical practice or the clinical application of our technology." To "train on [their] technology," Intuitive Surgical produces a four-level training program, but because the law prevents them from training on "clinical practice or the clinical application of [their] technology," the company cannot legally enforce rules stating that surgeons must complete the activities (Siegel et al., 2018, para. 30). The FDA also does not have legal authority to administer training and education requirements. According to Dr. Robert Poston, chief of cardiothoracic surgery at SUNY Downstate Medical Center, "the root cause [of complications] here is the training …. The willingness to sell robots to people and promote them

doing surgeries when they weren't adequately trained, the willingness of hospital credentialing committees to sign off on them and allow them to do it." Here, Siegel et al. (2018) attributes surgical complications to the lack of training, placing the blame on the "willingness" of companies to "sell … and promote" people using robots to perform surgery "when they weren't adequately trained," as well as hospital credentialing committees who "sign off … and allow" these surgeries to proceed without concern for the consequences (para. 34).

From these interviews, it is apparent that hospitals then have the say in how much training is required. Organizations such as the FDA and Intuitive Surgical cannot fully fulfill the missions set by their roles in the network during enrolment due to their inability to enforce training requirements (Siegel et al., 2018). In Featherstone's case, the surgeon performing the operation must have had permission from the hospital credentialing committee to use the dVSS. However, it is unclear what training requirements this committee established. Given the number of injuries arising from the surgery, including a ureter burn which must have been caused by the robot, it is not unreasonable to question the competency of the surgeon and whether he received adequate training. In order to represent the questionable robotic surgery skills of the surgeon, Figure 2 displays a dashed purple line for the association between the surgeon and the dVSS. To represent the legal training restrictions on organizations in the actor-network, Figure 2 displays dashed purple lines for the associations connecting Intuitive Surgical and the FDA to the dVSS. Finally, to portray the willingness of the hospital credentialing committee to approve the surgeon's use of the dVSS without full justification, Figure 2 uses a dashed purple line to connect the hospital credentialing committee to the surgeon and dVSS.

Figure 2

Actor-Network Diagram for the Featherstone Case in Practice



Note. C is the surgical department chairman, IS is Intuitive Surgical, FDA is the U.S. Food and Drug Administration, HCC is the hospital credentialing committee, dVSS is the da Vinci Surgical System, S is the surgeon conducting the hysterectomy, ST is the support team, U is the urologist, and P is the patient.

Conclusion

Using the ANT framework, I reconstructed the actors and associations within the network surrounding Laurie Featherstone's hysterectomy to determine weak links that led to the failure of the network to carry out a successful hysterectomy. I argued that social factors such as weak surgical group dynamics, failure of the surgeon to fulfill his obligations, and legal limitations on training requirements all contributed to the complications that Featherstone suffered. These new insights allow readers to better understand the variety of sociotechnical factors that can contribute to unnecessary problems resulting from a robotic hysterectomy. By considering the elements discussed in this paper, various social groups can take action to improve the safety of

future robotic surgeries, such as ameliorating group interactions, reminding surgeons to always follow the principle of care, and working towards a nationally enforced training requirement to perform robotic surgery.

Word Count: 3880

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