

---

## AN OPERATION MANAGEMENT APPROACH FOR FORENSIC SCIENCE

### CLAUDIO VILELA RODRIGUES

FACECA – Faculdade Cenequista de Varginha/MG – Rua Professor Felipe Tiago Gomes - Varginha/MG  
CEP: 37006-020 /Brazil  
E-mail: [claudiovilela@dep.ufscar.br](mailto:claudiovilela@dep.ufscar.br)

### MÁRCIA TERRA DA SILVA

Departamento de Engenharia de Produção, Escola Politécnica da Universidade de São Paulo – POLI-USP  
Av. Prof. Almeida Prado, travessa 2, n. 128, CEP 05508-070, Cidade Universitária, São Paulo-SP/Brazil  
E-mail: [mtsilva@usp.br](mailto:mtsilva@usp.br)

### OSWALDO MÁRIO SERRA TRUZZI

Departamento de Engenharia de Produção, Centro de Ciências Exatas e Tecnologia, Universidade Federal de São Carlos - UFSCar  
Rodovia Washington Luís, Km 235, CEP 13565-905, São Carlos - SP/Brazil  
E-mail: [truZZi@ufscar.br](mailto:truZZi@ufscar.br)

### Abstract

This research has been carried out in Forensic Science State agency through a longitudinal case study. Subsidiary data was collected from Forensic Science Service (FSS) in the Union and in five other States. Forensic Science is a public service designed to examine material vestiges in a crime scene in order to help police to find out the crime perpetrators and bring them to Justice and at the same time to promote human rights. To achieve its mission, the service applies scientific knowledge and technological devices. FSS service has a diversity of stakeholders, but its main clients are: judges, police investigators, prosecutors and defense attorneys. Politicians are a key stakeholder. FSS values are: (1) utility, when it links the suspect to a crime scene or innocent someone wrongly accused; (2) justice, in order to facilitate access to the service, independent of any pre-existing condition; (3) solidarity, both treating police, prosecution and defense equally, and producing evidence in human rights violation by law enforcement agents; and (4) aesthetics, because its way to produce evidence that apply scientific knowledge and it's not necessary to violate human rights. The Forensic Scientist competence and resources availability are the key critical factors do deliver value. This study refined the attributes of FSS. In terms of utility, it is necessary: (1) to have the crime scene isolated (Military Police) and preserved (Civilian Police); (2) FSS gets as fast as possible to crime scene; (3) guarantee the minimum quality to crime scene processing, according to scientific methodology and protocols; (4) guarantee the same at crime labs procedures; and (5) responsiveness in reporting FSS clients. (6) FSS must be universalized in order to guarantee that every case of the same kind will has the same treatment. In this point it's important to improve the interior branches facilities, recourses and facilities. (7) Solidarity dimension is complex, because to deliver this value it depends on changing institutional design by politicians. FSS needs independence, mainly from Police in order to avoid possible and even unconscious interference on the job. Finally, the service must be managed as a professional organization.

**Key words:** *Forensic Science Organizations; Public Services Operations Management; Forensic Science Services Operations Management; Human Rights.*

---

## AN OPERATION MANAGEMENT APPROACH FOR FORENSIC SCIENCE

### 1. Introduction

Brazil struggles for a long time with violence that in some way affects its people. In spite of this violence, the law enforcement agencies and its judiciary system must respond it respecting the human rights. In this social and political context one actor has key role to play: Forensic Science. Forensic Science makes the link between science and Justice. It's tools are scientific knowledge and technological devices applied to it. This paper addresses this kind organization based on an operations management view from the value it must deliver on.

Thus, the research problem is to refine FSS attributes based on the value (RODRIGUES, 2010) it must deliver. The research questions, which generated specific objectives, are to find out the role played by FSS in the Public Safety and Criminal Justice network, and if the FSS institutional design impacts its value deliver.

Finally, we propose some directions in designing the service based on the value it must deliver. Then, it's essential to specify its management requirements as a service, with its own concepts, objectives, and a differentiated service value, dealing with different competences.

The study motivation is the growing importance of Forensic Science in the Criminal Legal System, mainly because of Human Rights promotion, the advances of scientific knowledge and technological devices, which gives the forensic evidence a major weight on trials when compared with other ones.

This paper presents beyond this introduction, a section about methodology, another one about the theoretical background, a fourth about the discussions and findings, and finally, the conclusions.

### 2. Methodology

To achieve the objectives, a qualitative five years longitudinal and exploratory case study (YIN, 1995; EISENHARDT, 1989) was carried out in FSS in Minas Gerais/BRA State in order to map out the service process, to identify its main service characteristics and its main stakeholders. Subsidiary data was collected from FSS in the Union and in five other States.

Brazil is a federal constitutional republic comprising 26 states and a federal district. Public Safety is States responsibility, except for some violations under Union jurisdiction. That's the reason Minas Gerais was taken as one case.

The reason of the choice was the research question, and the phenomena contemporariness. Following a research protocol, multiple data methods (documental, interview, observation, organization archives, and technological devices) were used to collect data from FSS studied, and from the other actors involved in the interorganizational network. The different vision of each actor shaped the value of FSS. Results were analyzed and criticized based on theory (YIN, 1995; EISENHARDT, 1989; VOSS et al, 2002).

### 3. Theoretical background

Government must create value for society (KIRLIN, 1996; MOORE, 1995). According to the authors, it might be done basically in three different ways:

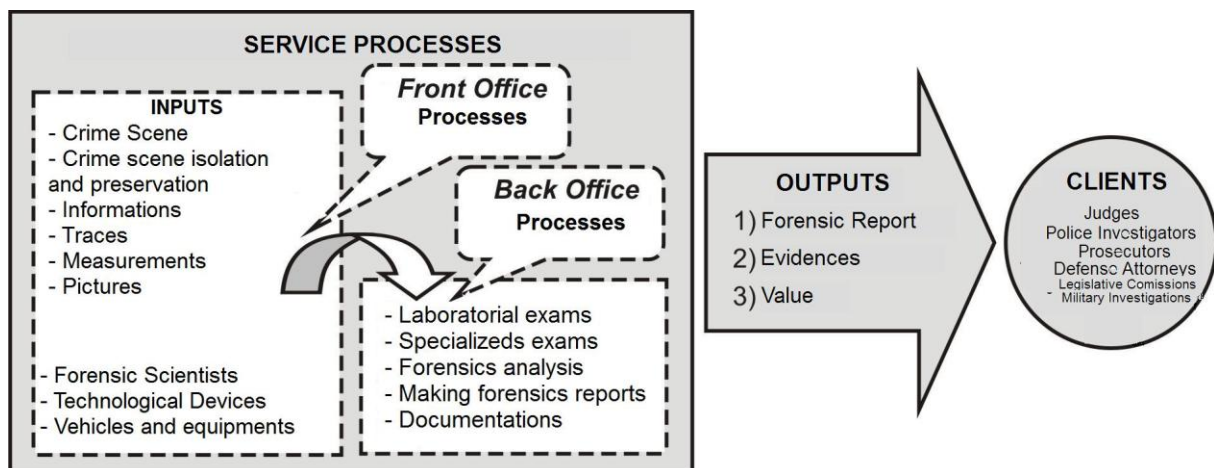
- a) Designing institutions through the law, mainly in constitutional level;
- b) Creating complex public systems;
- c) Managing the public organizations.

In this perspective, “operations management is the art of creating and delivering value” (JHONSTON; CLARK, 2005, p. 43). Based on Zarifian’s approach (2001), Rodrigues (2010) and Rodrigues et al (2010) analyzed the value that Forensic Science operations must create for society and deliver to its main stakeholders.

The value a service must create and deliver is based on the consequences for the final destinataries of the service, and the necessary resources to generate the desired results. The consequences for the destinataries are analyzed under four dimensions: (1) utility, in the way the service must generate useful results for the destinataries; (2) justice, meaning that everyone, independent of any pre-existing conditions has the access to the service; (3) solidarity, in terms of promoting social inclusion; and (4) Aesthetics, meaning that the service must be beautiful. Under the resources perspective, the main resource is the competence of the forensic scientist and technology is auxiliary (ZARIFIAN, 2001).

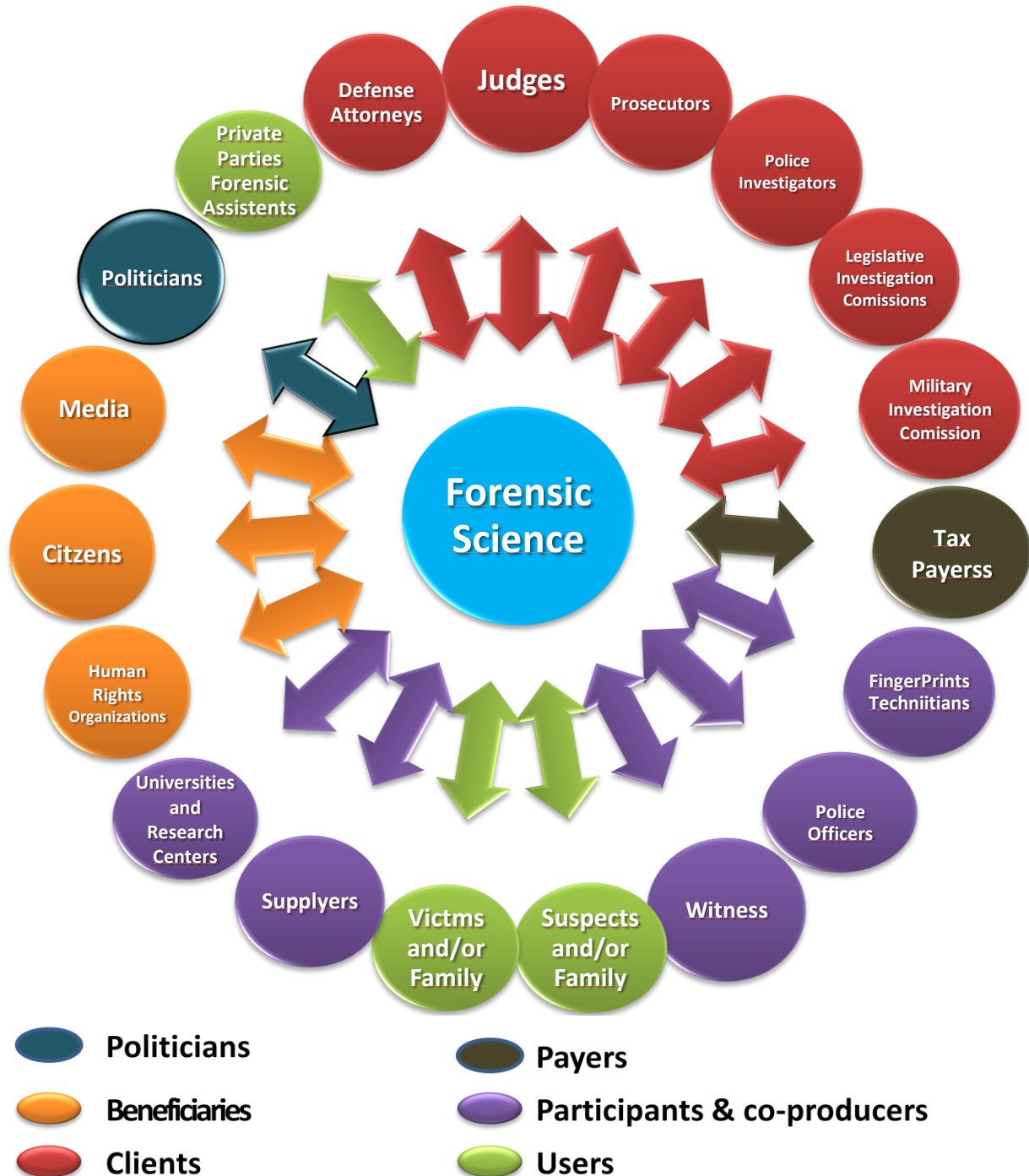
Forensic Science Services takes part in a Public Safety and Criminal Justice interorganizational network, with autonomous and interdependent actors, which the final goal is to deliver a value of Justice. FSS provides it with an input: the forensic evidence, one of the ten means of evidence in Brazil. The service is mandatory in every crime where vestiges were left; not even the suspect confession can replace it. It has been gaining relevance in the judicial verdicts, among other reasons because technological advance and Human Rights promotion (RODRIGUES, 2010; RODRIGUES et al, 2010).

The process starts with Military Police (MP) (Patrolling Police) getting to the crime scene and isolating it, and, then, call the Civilian Police (CP) (Investigative Police). The Civilian Police preserves the crime scene until the arrival of Forensic Science. The time length depends on distance, weather and traffic conditions, and means of transportation. It is used regular cars, not special ones. The Forensic Science look for traces and collect physiological material, take measures and pictures, and so on. The investigation by Civilian Police should start immediately, but it not always happens. After the exams, Forensic Science makes a report and sends it to Police Investigators. Then, Civilian Police makes a final report to the prosecutor, who might to suit or not the suspect. If the prosecution does it, there is a trial, where, at the final, the Judge (or a Jury depending on the type of crime) will decide if the defendant is guilty or innocent. In an affirmative case, apply the sentence. The final result depends on the quality of job of each actor in this supply chain (RODRIGUES, 2010; RODRIGUES et al, 2010).



**Figura 1.** Forensic Science simplified service processes (Inspired in Johnston and Clark, 2005, p. 175).

It presents peculiar characteristics, mainly in front office operations, which follows a layout by fixed position and has to deal with the unexpected. FSS association with science highlights its intangibility. FSS has a diversity of stakeholders with complex demands, even conflicting in some situations (Figure 2). FSS output is addressed to police investigators, prosecutors, defense lawyers and judges (Figure 1). In sum, the service main clients. Although, a lay person may see the victim (or suspect) as an end user, he/she is user and/or participant (when helping with samples) of FSS, but he/she is a client of the whole supply chain (RODRIGUES, 2010; RODRIGUES et al, 2010).



**Figura 1.** Forensic Science service main stakeholders (RODRIGUES, 2010).



The Forensic Science Service utility is to deliver a material, objective evidence, that link the suspect to crime scene or innocent someone wrongly accused. In this way it gives support to a history, where suspect's actions are analyzed before the law, debated by defense and prosecution, and finally sentenced by a judge on a trial. Supplementary, it helps to avoid illegal investigation methods, like torture to get confessions (RODRIGUES, 2010; RODRIGUES et al, 2010).

The service justice value is to allow everyone to access it, independent of any preexisting condition, and every case should get the same attention. The research showed that those cases that caught on the media or involving very important people, gets more attention (RODRIGUES, 2010; RODRIGUES et al, 2010).

Solidarity has to do with impartiality, which means to give defense and prosecution an equal treatment. This dimension is more difficulty to deliver on those federation unities, where Forensic Science Service is subordinated to Police. Many studies demonstrates that in those cases the Police and Prosecution theses influence and drive the Forensic Scientists perceptions (BUDOWLE, 2009; RODRIGUES, 2010; FISHER, 2004; GIANNELLI, 2007; GIANNELLI, 2008; KOPPL, 2005; THE JUSTICE PROJECT, 2008; THE UNITED STATES, 2009). Another key issue is crimes involving human rights violations by State agents, where most of the victims comes from lower classes or from certain racial groups (ASTON, 2008; ASTON, 2009; PIOVESAN; SALLA, 2001). In Brazil, torture is crime (BRASIL, 1997). In this case, Forensic Science is decisive to punish the wrong doers, because those crimes rarely have eye witness. So it must be independent from Police agencies to delivery this value (BRASIL, 1996; BRASIL, 2002; BRASIL, 2009; RODRIGUES, 2010).

Finally, the aesthetic dimension is to investigate crimes and find out its perpetrators without being necessary to violate human rights. This dimension, probably explain the success of TV series that portrait the activities (RODRIGUES, 2010).

In terms of resources Forensic Science job requires a variety of fields' background knowledge that must be applied to help solving crimes, like chemistry, physics, biology, engineering, pharmaceutical, and computer science, for instance. Besides this background knowledge there are the professional upgrade courses and own experience (RODRIGUES, 2010; RODRIGUES, et al, 2010; JAMES; NORDBY, 2005; FISHER, 2004). Forensic Science professional should be trained to think and act as scientists (JONAKAIT, 1991). They also need competences to incorporate new technologies and to develop a dialogical communication with its main stakeholders. One of the problems is that this communication is in most of the cases the kind of written instrumental. At the end, the forensic scientist doesn't know what was the final contribution of their report (RODRIGUES, 2010; RODRIGUES et al, 2010).

The technological devices are auxiliary and very important for their job. In many cases it involves complex technologies as DNA exams, chromatography, specials softwares in order to help in ballistics and finger prints identifications, chemical products to recognize blood, chemical powders to lift finger prints at crime scenes, among many others. The fact of matter is that technology has a strong weight on service delivery (RODRIGUES, 2010; RODRIGUES et al, 2010).

The final conclusion is that FSS value is associated with its intangibility, which links it with science and technology, and it contributes to fairness and impartiality Justice ideal. FSS institutional design influences value delivery, because if it's dependent on Police budget, and reward and punishment system, it's harder to deliver fairness. Therefore, it is necessary to redesign FSS independent from any other public agency, with its own public budget, in order

to realize its full potential value (KOPPL, 2005; RODRIGUES, 2010). It also should be designed as a professional organization instead of a bureaucratic one (MINTZBERG, 2009).

#### 4. Discussions and findings

The goal of this research is to refine the attributes of Forensic Science Service based on the value it must deliver and suggest directions for its organization. Attributes here means those key factors that must be delivered at some specified service level (JOHNSTON; CLARK, 2005, p. 117). These attributes might be managed through an attribute control chart.

First of all, analyzing the service process, it's clear that the isolation and preservation of crime scene by the first responders is a critical factor for success in this operation. The quality of crime scene isolation and preservation are under the jurisdiction of Military Police and Civilian Police, respectively.

There are failures in this process. In many cases Civilian Police doesn't show up at the crime scene and the isolation and preservation is not well done. Another point is that there are no consequences for those who violate isolation and preservation of crime scenes. In this case, the Forensic Science professional must assess this attribute in every case: if it is isolated and preserved or not.

Second, the service needs better and faster means of transportation in order to get earlier at crime scenes. Some complain that in many cities with heavy traffic they get backed up on traffic jam, what delays their arrival at crime scenes. Maybe in some critical cases, even helicopters might be used to transport and guarantee a quickly arrival at crime scenes in order to avoid lose vestiges. Besides, a constant time measure and analysis should be carried out in order to assess this attribute impact on the job performance.

Once at crime scene, the quality of the exams is so critical to deliver value, because in most of the cases it will not be possible to do it again. There are lack of continuously training and incorporation of new technologies, mainly in those offices located in interior. The most sophisticated exams, in generally, exists only at the headquarters on federation unity capital.

This factor becomes more critical once the service trend is to take the laboratory to the crime scene, except for some sophisticated exams, using vehicles customized for that. There aren't methodologies and protocols to forensic exams in the State of research and in most of them in Brazil. It's something that is being built in Brazil. So, in this issue it's important to define these methodology and protocols and check if they are being followed by the Forensic Science practitioners. It must be evaluated by the managers and clients of the service.

The key issue here is: has the service produced robust evidence that make possible to link the suspect to crime scene (or innocent someone wrongly accused) or tell what really happened in a specific event? And more, if it was carried out according with the methodology and protocols. They same procedure must be carried out by the crime lab managers.

And yet in terms of utility, is important to issue the report on quickly time. According to the law, it must be done at most in ten days. In Minas Gerais State until last year the measurement of the number of the days for the report conclusion for violent crimes was monitored and defined in 30 (thirty) days. Responsiveness must go on being assessed in any lack in time must evaluated according to legal and operational standards, mainly in terms of resources availability.

In terms access its very import to guarantee if every case is having the same minimal quality standard, and if every cases that the law requires forensic exams are being carried out. This control might be done by the clients (judges, prosecutors, defense lawyers, and police investigators), once they are powerful enough to make it true. It's the same kind of assessment in the quality issue.

In terms of human rights promotion the impartiality among the different actors requires and the production of evidence in cases of human rights violation by law enforcement agents requires independence from police. Independence in terms of management, resources, public budget, punishment and rewards, internal affairs, in sum: an institutional design with a proper organizational structure that promote it. And only the politicians have the necessary authority and legitimacy to carry it out.

In order develop the necessary competences and to have access to resources the service need, it also depends a lot on the new institutional design. Any way it's important to assesses in every exam if the professional has the necessary competence to perform it and if he/she counted on with the right resource to carry it out.

Finally, FSS must be managed as a professional organization, where its operational level is critical for the operation success. Another important issue is FSS improves its communication with its main clients in order to deliver what is necessary to contribute to public safety and criminal judicial system in order to create value for society.

## 5. Conclusions

This research refined the attributes of FSS in order to it creates value for society and gave the directions to organize this service as a professional organization. In spite of our democracy and advances in public management in Brazil, and particular, in Minas Gerais State, it is still necessary to go further in terms of institutional design, investments in management, and in its operations mainly in terms of facilities, competences development and technological devices acquisitions in order to create and deliver value for society.

The attributes refined in this research were: (1) Crime scene isolation and preservation; (2) responsiveness both to crime scene and report completion; (3) the quality of the crime scene exams and procedures, mainly if it linked the suspect to the crime scene (or innocent someone wrongly accused); (4) if FSS is creating all conditions to universalize the service and its quality, independent of any pre-existing condition for persons, location, gender, religious faith, political ideology, race; (5) impartiality before police, prosecution, defense, and judge; (6) availability of the necessary resources to carry out the demanded exams; (7) a non-stopping training and new technological devices incorporation by Forensic Science service members.

The study encourages reflections about the difficulties of applying service operations management concepts to a public organization that is changing, and it's characterized by the diversity of stakeholders and by its fluid and poorly defined, although important value.

Finally, we suggest new researches in terms of the service organization, performance measurement for its attributes, and the competences requirements for the service, in order to create and deliver value for society.

## References:

ASTON, P. **Promotion and protection of all human rights, civil, political, economic and cultural rights, including the right to development**: Report by the Special Rapporteur on extrajudicial, summary or arbitrary executions. United Nations. General Assembly. Eight session, Human Rights Council, Agenda item 3 – Mission to Brazil, May, 2008.

Disponível em:

[http://www.extrajudicialexecutions.org/application/media/%28Brazil%20Prelim%29%20A\\_HRC\\_8\\_3\\_Add\\_4.pdf](http://www.extrajudicialexecutions.org/application/media/%28Brazil%20Prelim%29%20A_HRC_8_3_Add_4.pdf) >. Acesso em: 15/09/2008.

ASTON, P. **Promotion and protection of all human rights, civil, political, economic and cultural rights, including the right to development**: Report by the Special Rapporteur on extrajudicial, summary or arbitrary executions. United Nations. General Assembly. Eleventh session, Human Rights Council, Agenda item 3- Addendum Mission to Brazil, MAR, 2009. Disponível em:  
<[http://www.extrajudicialexecutions.org/application/media/\(Brazil\)%20G0912622.pdf](http://www.extrajudicialexecutions.org/application/media/(Brazil)%20G0912622.pdf)>.  
Acesso em: 21/07/2009.

BEHN, R. The big questions of public management. **Public Administration Review**, v. 55 n.4, p.313-24, 1995.

BRASIL. Decreto 1904, de 13 de maio de 1996. **Programa nacional de direitos humanos – PNDH I**. Disponível em: < <http://www.justica.sp.gov.br/pedh/pdf/pndh1.pdf>>. Acesso em: 28/11/2008.

BRASIL. [Decreto nº 4.229, de 13 de maio de 2002](#). **Programa nacional de direitos humanos II – PNDH II**. Brasília: Secretaria de Estado dos Direitos Humanos, 2002. Disponível em: <<http://www.mj.gov.br/sedh/pndh/pndhII/Texto%20Integral%20PNDH%20II.pdf>>.  
Acesso em: 28/12/2008.

BRASIL. [Decreto nº 7.037, de 21 de dezembro de 2009a](#). **Aprova o programa nacional de direitos humanos - PNDH-3 e dá outras providências**. Brasília: Secretaria Especial de Direitos Humanos da Presidência da República. Diário Oficial da União de 17.12.2009. Disponível em: < [http://www.planalto.gov.br/ccivil\\_03/\\_Ato2007-2010/2009/Decreto/D7037.htm](http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2009/Decreto/D7037.htm)>. Acesso em: 18/12/2009.

BRASIL. [Lei nº 9.455, de 7 de abril de 1997](#). **Define os crimes de tortura e dá outras providências**. Disponível em: < <http://www.planalto.gov.br/ccivil/LEIS/L9455.htm>>.  
Acesso em: 21/09/2009. BRYMAN, A. **Research methods and organization studies**. London: Routledge, 1989.

BUDOWLE, B. et al. A perspective on errors, bias, and interpretation in the forensic sciences and direction for continuing advancement. **Journal of Forensic Sciences**, v. 54, n.4, p. 798-809, 2009.

EISENHARDT, K. M. Building theories from case study research. **Academy of Management Review**, v. 14, n.4, p. 532-550, 1989.

FISHER, B. A. J. **Techniques of crime scene investigation**. 7th. ed. Flórida: CRC, 2004.

GIANNELLI, P. Confirmation bias. **Criminal Justice**, v. 22, n. 3, p. 60-1, 2007.

GIANNELLI, P. **Wrongful convictions and forensic science**: the need to regulate crime labs. Case Western Reserve University – School of Law, Jan. 2008. Disponível em: < <http://www.oranous.com/florida/JimmyAtes/SSRN-id1083735.pdf>>. Acesso em: 19/09/2009.



- JAMES, S. H.; NORDBY, J.J. **Forensic Science**: an introduction to scientific and investigative techniques. 2. ed. Florida: CRC, 2005.
- JOHNSTON, R.; CLARK, G. **Service operations management**: improving service delivery. 2nd ed. London: Prentice Hall, 2005.
- JONAKAIT, R.N. Forensic science: the need for regulation. **Havard Journal of Law & Technology**, v.4, p. 109-191, 1991.
- KIRLIN, J. J. What government must do well: creating value for society. *Journal of Public Administration Research and Theory*”, Vol. 6, N. 1, pp. 161-185, 1996.
- KOPPL, R. How to Improve Forensic Science. **European Journal of Law and Economics**, v.20, n.3, p. 255-286, 2005. Disponível em: <[http://www.reason.org/ps364\\_forensics.pdf](http://www.reason.org/ps364_forensics.pdf)>. Acesso em: 16/09/2009.
- MINTZBERG, H. **Criando organizações eficazes**: estruturas em cinco configurações. 2. ed. Tradução de Ailton Bomfim Brandão. São Paulo: Atlas, 2009, 334p.
- MOORE, M. H. Creating public value: strategic management in government. Cambridge/MA: Havard University Press, 1995.
- PIOVESAN, F.; SALLA, F. Tortura no Brasil: pesadelo sem fim? **Ciência Hoje**, v.30, n.176, p. 30-33, out., 2001.
- RODRIGUES, C.V. **Perícia criminal**: uma abordagem de serviços. 255f. Tese (Doutorado) – Programa de Pós-Graduação em Engenharia de Produção - Universidade Federal de São Carlos, São Carlos, 2010.
- RODRIGUES, C. V.; TERRA DA SILVA, M.; TRUZZI, O. M. S. **Perícia criminal**: uma abordagem de serviços. *Gestão & Produção*, v.17, n.4, p. 843-857, 2010.
- THE JUSTICE PROJECT. **Improving the practice and use of forensic science**. Washington, DC: The Justice Project Inc. and The Justice Project Education Fund, 2008. Disponível em: < <http://www.thejusticeproject.org/wp-content/uploads/forensics-fin.pdf>>. Acesso em: 20/09/2009.
- THE UNITED STATES. National Research Council. Committee on identifying the needs of the forensic sciences community. **Strengthening forensic science in the United States**: a path forward. Washington, D.C.: The National Academies, 2009. Disponível em: < [http://www.nap.edu/catalog.php?record\\_id=12589#toc](http://www.nap.edu/catalog.php?record_id=12589#toc)>. Acesso em: 01/09/2009.
- VOSS, C.; TSIKRIKTSIS, N.; FROHLICH, M. Case research in operations management. **International Journal of Operations & Production Management**, v. 22, n.2, p. 195-219, 2002.



---

WEISS, R. S. **Learning from strangers**: the art and method of qualitative interview studies. New York: Free Press, 1994. 246p.

YIN, R. K. **Estudo de caso**: planejamento e métodos. Tradução de Daniel Grassi. 3. ed. Porto Alegre: Bookman, 2005. 212p.

ZARIFIAN, P. Valor, organização e competência na produção de serviço: esboço de um modelo de produção de serviço. In Salerno, M.S. (Ed.), **Relação de Serviço**: produção e avaliação, SENAC, São Paulo, 2001, pp 95-149.