

Causes of Delay in Lahore Orange Line Metro Train Project

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Abstract- During the last decade there is tremendous increase in the construction activities in Pakistan. Most of the development projects including orange line metro project are not completed within the allocated time and cost. It is necessary to identify the factors causing delay in such important projects. This study is carried out to establish the reasons due to which orange line metro project faced serious delays in its completion. For this purpose, a questionnaire consisting of 38 activities causing expected delays is prepared and distributed in all the eight zones of metro train transit project. Data collected from the sites has been processed, analyzed and results presented through bar charts. On the basis of the results it is observed that stay orders from the higher courts, late delivery of land by the client, frequent changes by the owner, non-payment of cash on time, late procurement of material at site and sudden cancellation of contract at package-2 are considered to be the most significant factors causing delays in orange line metro train project.

Index Terms-- Construction Projects, Delay Causes, Pakistan.

I. INTRODUCTION

The **Orange Line** is an automated rapid convention system under construction in Lahore, and Pakistan's first modern rail-based mass rapid transit system.

A. Client:

The project was launched in May 2014 with a memorandum signed between the Government of Pakistan and the Government of China. The Lahore Development Authority and the Government of Punjab are clients of the project.

B. Contractor:

There were three main contractors working on this project, namely;

- **Habib Construction Services** was awarded a civil works package-1 worth Rs 21.49 billion in October 2015
- **ZKB Engineers and Constructors** for Civil Work (Package 2) between Chauburji and Ali Town at a cost of Rs.11.39 billion.
- **Sarwar Construction Company** was awarded (package 4) for civil works at Ali Town.

C. Consultant:

Under a joint venture, the consultants of the **China Railways Engineering Consulting (CREC)** and the **National Engineering Services Pakistan (NESPAK)** started monitoring the structural work of the Orange Line Metro project. The consultancy cost of the project was Rs 2.4 billion.

D. Distribution of Work on Project:

Project was distributed in 4 packages:
Package 1 starts from Dera Gujran to Chauburgi (13.6km)
Package 2 is from Chauburgi to Ali town (13.5km)
Package 3 consists of depot located near Dera Gujran
Package 4 contains the yard located near Ali town

E. Track Length:

The track length of Metro Train project is 27.1km. 25.4 km of the line is elevated (Fig 1.1), while 1.72 km is underground (Fig 1.2), and 0.7 km of track is laid in the transition zone between elevated and underground sections.

F. Rout Details:

Orange line starts from Dera Gujran (G. T. Road) and terminates at Ali Town (Thokar Niaz Baig). It has 26 metro stations as shown in Fig-1.3



Figure 1.1: Structure of Orange Line Metro Train



Figure 1.2: Underground Track

G. Start and Finish Time of Project:

Construction of the project began in October 2015. The deadline for completion of the project was December 25, 2017, but due to pendency of cases in the superior courts it was delayed. The Chinese government had also expressed concern over delay in the project,

H. Financer of Project:

Funding for the project was secured in December 2015 when the Exam Bank of China agreed to provide a soft loan of \$ 1.60 billion for the project.

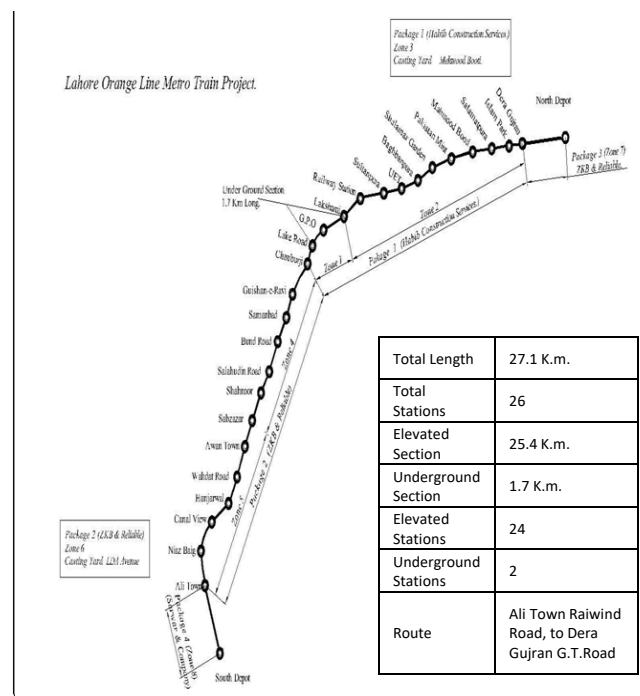


Figure 1.3: Route Map of Orange Line Metro Train

I. Detail of Various Packages:

Package 1:

Habib Construction Services started working on Package 1. It consisted of three zones,

- i. **Zone 1:** This zone was situated between Chuburgi and Lakshmi Chowk. Underground portion of Lahore Orange Line Metro Train Project was located in this zone.
- ii. **Zone 2:** This zone covered track from Lakshmi Chowk to Dera Gujran. This contained Elevated portion of track.
- iii. **Zone 3:** This zone was situated in Mehmood Booti. Casting yard of package 1 was located in this zone.

Package 2:

ZKB Engineering/Construction Company was working on Package 2. It covered three zones

- i. **Zone 4:** This zone was spread between Chuburgi to Sabzazar station. This consisted of Elevated portion of track.
- ii. **Zone 5:** This zone covered area between Sabzazar to Ali Town station. This is Elevated portion of track.
- iii. **Zone 6:** This zone is located in LDA Avenue. Casting yard of package 2 was located in this avenue.

Package 3 (Zone 7):

Package 3 contained depot located near Dera Gujran

Package 4 (Zone 8):

Package 4 contained depot located near Ali Town.

II. LITERATURE REVIEW

Luu Truong Van N.M [1] designed a theoretical model to know the attributes affecting the government sponsored projects. He developed a conceptual model of delay factors mostly related to law and administrative procedures. In the model they identified 28 delay factors, three of which were important factors that influenced the completion of the project. Those factors were information delays and lack of communication between the parties, incompetent owner and lack of competency of supervision consultant. The maximum delay depended upon the contractor and owner who had the main control upon the completion of project. S Shuja Safdar Gardezi [2] conducted a survey upon fifty projects through a questionnaire and information causing delay in construction industry were identified. There were 25 significant delay attributes from seven major groups of client, contractors, consultant, materials, labor, equipment, and contract related factors. The analysis showed that the most important factors were ten out of which top most factors were law and order situation, terrorism, inflation, design changes, lack of funds, payment delays and political influence. Mohammad Khoshgoftar [3] carried out a survey among the government sponsored projects to identify causes of delay in construction projects. The survey was conducted through questionnaire distributed to Iranian construction companies. The questionnaires were distributed to thirty clients, forty consultants and fifty-five contractors. The completed questionnaires were analyzed on the relative importance index method. The most important cause of delay in Iranian work were improper planning, site management, lack of communication between the parties, improper procurement of materials and change in orders etc. Ghulam Abbas Niazi [4] carried out survey in Afghanistan through questionnaire amongst sixty construction industries consisting of consultants, clients, and contractors. The collected data were analyzed through significance index method. Three major parties client, consultant and contractors were the main causes of delay. The important causes of delay were security, corruption, poor qualification of contractors, technical staff, poor site supervision and bureaucracy in government agencies. Adel Al-Kharashi [5] carried out a comprehensive survey in main seven groups of client, contractor, consultant, materials, suppliers, labor, contract and relationships. The survey was conducted for 86 clients, contractors and consultants involved in Saudi construction industry. The results showed that main causes of delay in construction industry were the lack of knowledge of respondents and dispute between consultants and contractors. The most important cause was absence of experienced persons involved in supply of manpower in the industry. The above research work showed that all countries had own-socio economics conditions and thus had their own reasons of delay in their construction activities.

This study is limited to Orange Line Metro Train project in Lahore; Pakistan, which was to be completed by joint venture of Pakistan & China. The causes of delay identified are not similar to the above-mentioned studies.

III. DATA COLLECTION

Data collection was spread over two phases. First phase was to collect data from 8 zones of the project. A specific questionnaire was proposed for gathering information from different zones. Questionnaire was firstly distributed on eight zones as pilot project. Information obtained was discussed with experienced personnel at site and their comments were included in the questionnaire. The final form of questionnaire (attached as annexure) was distributed at site and interviews were held with the site engineers and incharges of the zones. In total there were six questionnaires which were completed at each zone. Each questionnaire collected information regarding the delay factors of the followings:

1. Client,
2. Consultant,
3. Contractor,
4. Materials,
5. Equipments,
6. Miscellaneous.

The factors contained further details of activities in percentage of delay occurred at each zone mentioned under each factor. The reasons for delay were also mentioned therein.

The data was collected through final year students and the staff deputed for this purpose. During collection of the data our staff/students experienced various difficulties at site. Few were as under: -

- i) The site staffs were reluctant to cooperate in giving correct information.
- ii) Information required to be collected from files were difficult to be obtained.
- iii) Mostly information obtained from contractor did not match with the one obtained from the client and the consultant.

The second phase was to analyze the collected data and draw bar charts for the activities of each factor mentioned above. Critical attributes were mentioned in the analysis and discussion upon the data was completed.

During collection of data six questionnaires were filled at each zone. Each factor further contains different activities which caused delay in each zone. The information collected from different zones were analyzed and bar charts prepared for all the factors. Data collected at each zone for all the six factors mentioned above with the detailed activities related to each factor i.e. (Client, Consultant, Contractor, Material, Equipment and Miscellaneous) was analyzed separately for each factor at each zone and thus 48 bar charts were prepared and analysis was done. The causes of delay in percentage were obtained.

IV. ANALYSIS AND DISCUSSION ON COLLECTION OF DATA

In order to establish the factors affecting the efficiency of construction projects, the data collected against each activity

from 8 zones is analyzed and average value calculated from bar charts drawn for this purpose.

Discussion on delay

Client

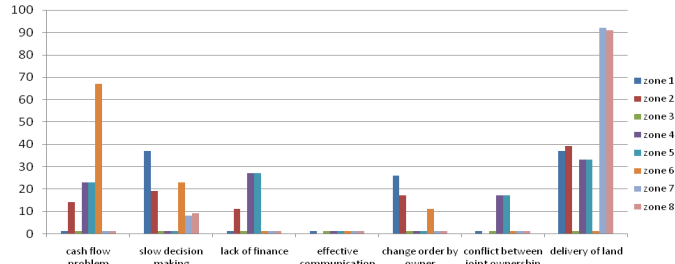


Figure 2.1: Client - Related Causes of Delay

From figure (2.1) it can be concluded that the factor which is considered most important is the late delivery (40.375%) of the land by the owner. The other factor causing delay are cash flow (15.5%) and slow decision making (12%) due to which the projects could not be completed in time. Several claims of extension in time period and change of orders made by the consultants and contractors against the decision of the client badly affected the progress of work. The client is supposed to make appropriate decision well in time as to avoid unnecessary delay in the completion of the project. Quick and good decision of the client will have positive effect on other ongoing projects of the client.

Consultant

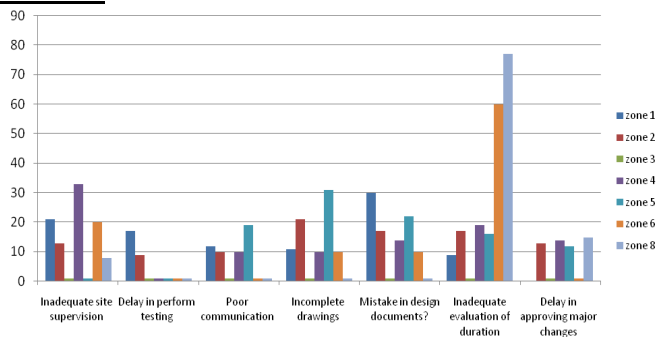


Figure 2.2: Consultant - Related Causes of Delay

From figure 2.2, it can be concluded that the factor which was considered most important was mainly inaccurate estimation of the completion period of the project (24.6%). Delay due to deficient site supervisory staff (12.125%) and faults in design documents (11.75%) were the other important factors. There are some delays which occurred due to manual errors can be easily avoided by deploying skilled and experienced work force.

Contractor

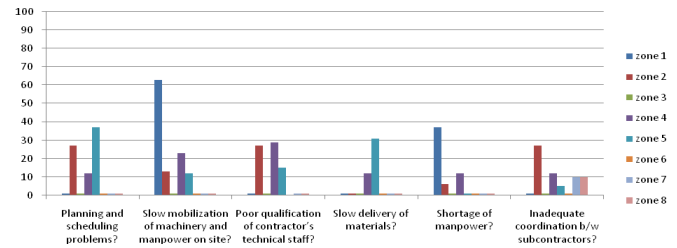


Figure 2.3: Contractor – Related Causes of Delay

From figure 2.3 it can be concluded that the factors which were considered most significant are slow mobilization of machinery and manpower on site (13.875%) and planning and scheduling problem (9.625%). The contractors should hire sub-contractors who are most experienced and having knowledge of work being assigned to them as their in-capabilities bring risk and bad name to the main contractors.

Material

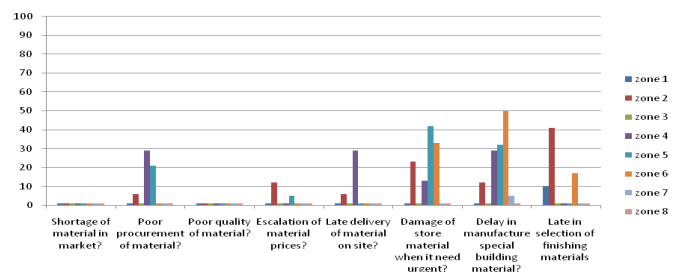


Figure 2.4: Material - Related Causes of Delay

From figure 2.4, it can be concluded that the factor which was considered to be the most important is in the case of the production of special type of building material at site (16.125%). Delays due to loss of stored material when it was needed urgently (13%) and late in selection of finishing material (8.5%) are considered to be equally important factors.

Equipment

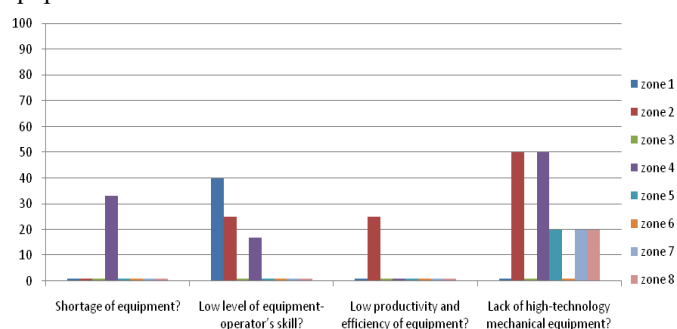


Figure 2.5: Equipment – Related Causes of Delay

From figure 2.5, it appears that lack of high technology mechanical equipment (20%) mostly affected the progress of work at site. Shortage of skilled employees (9.625%) and insufficient equipment (4.125%) have delayed the project work.

It is necessary to minimize such factor and to enhance incentives for the work force for in time completion of project.

Miscellaneous

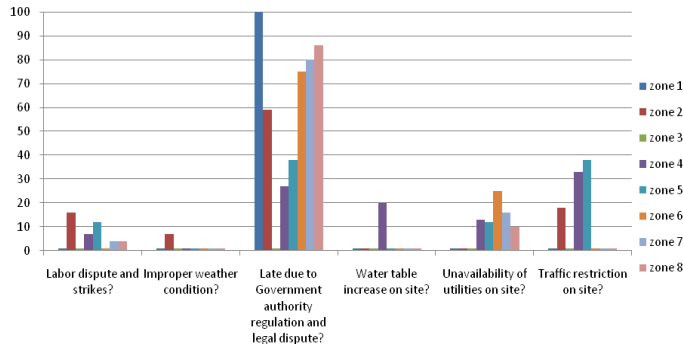


Figure 2.6: Miscellaneous Causes of Delay

From figure 2.6, it can be concluded that the factor considered to be the most important for diverse aspects is delay due to government authority regulations and legal dispute (57.875%). Delays due to traffic restrictions on the site (11.375%) and unavailability of utilities (8.375%) at site are not less important factors causing delay in the completion of work. Healthy working environment at site and encouraging incentives for the work force increase their productivity.

V. DISCUSSION ON RESULTS & CONCLUSIONS

Following conclusions below are extracted from the results presented earlier for the owner, consultant and contractor.

Client

The client and their representatives played an important part in controlling the progress of current works and also projects of the near future. Their vision showed how important is their role in improving the construction performance. It is important that owner should deliver land to the contractor before execution of work. Delay in cash flow problem and slow decision making are most important factors that delay the project. Clients have higher expectations on contractors to complete the project. The client's responsibility is to check the works of contractor already completed, list of sub-contractors, necessary equipment and all-round performance at such construction projects.

Consultant

Consultant had major role in construction. It is important that consultant should have ability to analyze and overcome the future outcomes. They should have carried out proper evaluation of time duration of the construction project. The factors which were considered most significant are inadequate evaluation of project, delay due to inadequate site supervision and frequent revision in design documents. If consultant took appropriate measures then it could ensure high performance of work force

Contractor

Contractors have an important role in influencing the performance of construction projects. Contractors should have the experience of handling of similar projects, procurement of materials, trained manpower and necessary equipment required at site to avoid any delay in the progress of work. The contractor with their efficient performance accelerates the work and thus creates good working relationship with the client and its representatives. The factors that were considered most important are the slow mobilization of machinery, lack of manpower on site and the planning and scheduling problem.

Other factors that were considered to be most important are the delay in the production of specific building materials, delay due to the loss of stored material when required and late in selection of finishing materials.

Delays due to traffic restrictions on site, low productivity of labor and non-availability of various site utilities were seen as the most important factors. Contractors should pay attention to the list of subcontractors and keep a close watch on the work of subcontractors.

Out of miscellaneous factors that caused delay of the project, litigation and legal aspects were the most prominent. The causes of litigation were the presence of heritage sites near the project layout and under-capacity of the contractors to execute such large-scale projects.

VI. RECOMMENDATIONS

Following recommendations are made for the client, consultant and the contractor to improve the work efficiency. Also, recommendations for future work are presented at the end.

Client

Late delivery of land by owner:

Owner, mostly in the form of development authorities, need to expedite their efforts in land acquisition. All the relevant government departments are required to be taken on board so that disputes related to land acquisition would be nipped in the beginning.

Cash Flow Problem:

Funds act as a fuel to the construction project. Cash flow problems arise due to poor accounting procedures, delay in payments and mal-practices resulting in pilferage and wastage of funds. Therefore it is suggested that timely transparent and fluent supply of funds be ensured to avoid unnecessary delays.

Consultant*Inadequate evaluation of duration*

Integrated project evaluation is required by keeping on board all the stakeholders from the beginning. Meticulous planning is required by the planning department.

Inadequate site supervision

Inadequate site supervision leads to uses of inferior materials and defects due to stupidity of workers. Experienced site supervisors should be deployed on site who should monitor all construction activities.

Mistakes in design documents

Design errors are inevitable as an important issue which has negative impact on the project and responsibilities should only be given to the experienced staff/firm in case of mega project.

- These documents should be checked and verified before finalization.
- Design which are done manually and with the help of software should be adequately vetted.
- Design responsibility should be given to the most experience staff/firm.
- Drawings should be scrutinized and reviewed carefully before finalization for construction.
- The issues of delays could have been minimized if there is good communication between consultant and client.

Contractor*Mobilization*

Mobilization is a process in which machinery, labor, equipment, offices and other facilities are shifted to the work zone. Successful and efficient mobilization reflect the level of commitment of the contractor.

1. The contractor should set up construction facilities in orderly designated and approved work areas for all labor and equipment which is necessary to complete the work.
2. If utilities are available on this site, a contractor would be at ease with mobilization.

Planning and scheduling problems:

Most effort should be put in planning and scheduling of construction activities. It help the engineers to develop the logic of how the work is to be executed.

1. Planning could be done only after careful study of drawings. Hence, drawings should be delivered on site before start of project.

Slow Decision Making:

1. Non-technical leadership in the project is the root cause of slow decision making. More technical personal should be accommodated in the command structure so as to expedite the process of decision making.
2. Well-trained project planning professionals could be appointed so they sort out the problems before time or cost overrun.

Traffic disruption

Construction activities disturb and hinder the traffic flow. These recommendations would be helpful for upcoming projects.

1. Alternate/temporary routes should be defined for smooth flow of traffic.
2. Special safety staff and traffic wardens should be appointed on the route of project to make sure the smooth and safe flow of traffic.
3. Heavy traffic on the construction routes should only be allowed in low intensity hours
4. Vehicle parking should not be allowed on the routes where construction activities are being carried out.

Litigation and Legal Issues:

The contractors must try that the disputes are preferably resolved within the project team without litigation. The resulting delay during the legal proceedings can harm their reputation and profit.

Future Works

In future, development works can be improved:

- Increasing face to face interviews with the senior and experienced staff at site.
- Improving questionnaire by taking opinion of the professionals with different backgrounds of construction projects.
- Conducting more exhaustive case studies of other construction projects causing unnecessary delays.
- Broadening the range of factors causing delays in the construction projects.
- Framing integrated system for assessing the causes of delays in the ongoing infrastructure projects in Pakistan.

APPENDIX

QUESTIONNAIRE

Zone _____ Date: _____

Client:

Consultant:

Contractor:

Start time: _____ Finish time: _____

Sponsor: _____

Introduction:

A. Various cases of delay:**1. Client Related Delay Factors:**

	Disagree (%)	Neutral	Agree (%)
Cash flow problem?			
Slow decision making?			
Lack of finance to complete the project?			
Effective communication and co-ordination between client and other parties?			
Change orders by owner during construction?			
Conflicts between joint-ownership of the project?			
Delivery of land to contractor on time?			

Reasons:**Consultant Related Delay Factors:**

	Disagree (%)	Neutral	Agree (%)
Inadequate site supervision by the consultant?			
Delay in perform testing by consultant?			
Poor communication and coordination between consultant and other parties?			
Incomplete drawings and late delivery of drawings on site?			
Mistake in design documents?			
Inadequate evaluation of project's duration?			
Delay in approving major changes in work?			

Reasons:**2. Contractor Related Delay Factors:**

	Disagree (%)	Neutral	Agree (%)
Planning and scheduling problems?			
Slow mobilization of machinery and manpower on site?			
Poor qualification of contractor's technical staff?			
Slow delivery of materials?			
Shortage of manpower?			
Inadequate co-ordination b/w subcontractors?			

Reasons:**3. Material related delay factors:**

	Disagree (%)	Neutral	Agree (%)
Shortage of material in market?			
Poor procurement of material?			
Poor quality of material?			
Escalation of material prices?			
Late delivery of material on site?			
Damage of store material when it needs urgent?			
Delay in manufacture special building material?			
Late in selection of finishing materials due to availability of many types in market?			

Reasons:

Equipment related delay factors:

	Disagree (%)	Neutral	Agree (%)
Shortage of equipment?			
Low level of equipment-operator's skill?			
Low productivity and efficiency of equipment?			
Lack of high-technology mechanical equipment?			

Reasons**2. Miscellaneous:**

	Disagree (%)	Neutral	Agree (%)
Labor dispute and strikes?			
Improper weather condition?			
Late due to Government authority regulation and legal dispute?			
Water table increase on site?			
Unavailability of utilities on site?			
Traffic restriction on site?			

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It is to be mentioned further that this research work has been carried out purely for the sake of academic purposes and any of its content should not quoted or considered for any legal purpose.

REFERENCES

- [1] Luu Truong Van, N. M. , (2015) A Conceptual Model of Delay Factors affecting Government Construction Projects (2015) ARPN Journal of Science and Technology, 2(5), pp. 92-100.

http://www.ejournalofscience.org/Download_Feb15_pdf_7.php

- [2] S. Shujaa Safdar Gardezi, Irfan Anjum Manarvi, S. Jamal Safdar Gardezi, (2014) Time Extension Factors in Construction Industry of Pakistan, *Procedia Engineering*, Volume 77, 2014, <http://dx.doi.org/10.1016/j.proeng.2014.07.022>
- [3] Khoshgoftar, M, Abu Hassan Abu Bakar & Omar Osman, (2010). Causes of Delays in Iranian Construction Projects (2010) *International Journal of Construction Management*, 10:2, 53-69. <http://dx.doi.org/10.1080/15623599.2010.10773144>
- [4] Gidado, Kassim and Niazai, Ghulam (2012) Causes of project delay in the construction industry in Afghanistan in: *EPPM2012*, University of Brighton, UK, 10-11th September, 2012. <http://eprints.brighton.ac.uk/11129/>
- [5] Al-Kharashi, A., Skitmore, M, (2009). Causes of delays in Saudi Arabian public sector construction projects (2009) *Construction Management and Economics*, 27 (1), pp. 3-23. <http://dx.doi.org/10.1080/01446190802541457>