CONSTRUCTION MOTOR VEHICLE ACCIDENTS IN SOUTH AFRICA: CAUSES AND IMPACT

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The focus of health and safety (H&S) in South African construction has resulted in a decrease in all classes of injury. However, approximately 40% of fatalities are attributable to MVAs in the course of employment and MVAs contribute a substantial percentage to the other classes, in particular, non-fatal permanent disabling injuries. Given the limited extent of public transport, the location of many construction sites, and the general use of non-enclosed light delivery vehicles (LDVs) and flat-bed trucks to transport workers, which are not secured to secured seats with seat belts when being transported, a study was initiated to determine the nature of transport used to convey workers, the incidence of MVAs and the resultant injuries, and the causes of such MVAs. The study entailed the completion of a self-administered questionnaire by contractors registered with the Construction Industry Development Board (CIDB). Findings include: workers sitting on sides / or beds of vehicles predominates in terms of unsafe transport / traffic practices contribution to injuries arising from MVAs; lack of secured seats, lack of seat belts, and lack of roll over protection exacerbate the injuries incidental to MVAs, and fall from vehicle in motion predominates in terms of the cause of MVA related injuries. Recommendations include: the implementation of a comprehensive traffic safety programme in all construction organisations and on all projects; conveyance of workers in appropriate vehicles, and banning of mixed transportation of materials, plant and equipment, and workers

Keywords: accident, construction, fatality, South Africa

BACKGROUND

Although, motor vehicle accidents (MVAs) as a subject area have captured the attention of researchers in other countries such as Turkey and the United States of America (USA), this is not the case in South Africa. Despite the revelation inside the 2009 Construction Industry Development Board (cidb) report entitled 'Construction Health & Safety in South Africa: Status & Recommendations', the uptake in MVAs related studies can be considered non-existent in the sector. The cidb report revealed that with 47%, the dominating cause of fatalities among other causes is MVAs (cidb, 2009). This revelation corroborates a previous assertion that MVAs contribute

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substantially to fatalities and injuries in construction because of common unsafe transport / traffic practices (Smallwood, 2002). Such practices are not limited to: non-wearing of seat belts; workers sitting on the sides and beds of vehicles; workers mounting or dismounting from moving vehicles and the overloading of vehicles, and non-roadworthiness of vehicles.

As mentioned earlier, the menace of MVAs have been addressed in, inter alia, Turkey. In fact Mungen and Gurcanli (2005) suggest that as the fourth leading cause of deaths in Turkish construction, MVAs related research and preventive safety efforts should be given a greater priority. In another empirical study conducted in Turkey, Gurcanli, Mungen and Akad (2008) observed that MVA related fatalities were due to negligence of basic safety measures. They suggested that employees responsible for traffic safety should be trained and H&S programmes should be continuously re-evaluated. These findings in the literature mirrored MVA related events in South Africa.

It is notable that MVAs involving construction workers are significant in work zones because of the severity of such accidents. Three of such accidents involving workers: worker struck-by vehicle inside work space; worker struck-by vehicle entering / exiting work space, and flagger struck-by vehicle; usually account for fatalities and injuries (Mohan and Zech, 2005). Thus, the overarching vision of this study is to reverse the increased MVAs related trend in South Africa through a literature review and a pilot survey conducted in South African construction. When these are concluded, they will form the basis for a comprehensive questionnaire and an interview guide that will generate the primary data for the study. The pilot survey constitutes the basis for this paper, which resulted from a study that was aimed at determining the nature of transport used to convey workers, the incidence of MVAs and the resultant injuries, and the causes of such MVAs.

RESEARCH RATIONALE

According to Emuze and Smallwood (2012), the South African construction industry is presently grappling with MVA related issues. They contend that in spite of increased awareness in the form of academic and media reports, MVAs appear to be increasing in South African construction. In particular, there has being a steady rise in MVAs in South African construction since 2001 when available statistics are considered. The statistics show that between year 2000 and 2006, the rank of MVAs among other causes was between 6 and 5. However, from 2007 onward, the statistics indicate an increase in the malaise. In particular, since 2007, the numbers of accidents have been oscillating between 850 and 950 as indicated in Table 1. It is notable that 984 MVAs and 63 fatalities occurred in the year 2010 alone. In effect, MVAs have emerged as a major cause of fatalities and permanent disabilities in South African construction. In order to examine the reporting of MVAs by the South African media, Emuze and Smallwood (2012) used 4 newspaper reports to illustrate the causes and impacts of MVAs in the sector. For example, a case shows that eyewitnesses reported that a ready mix concrete truck driver lost control while driving to a construction site. The vehicle swerved, overturned and crushed oncoming vehicles adjacent to the construction site (La Grange, 2009). Three people died in the accident.

As a result of consequences concerning permanent disabilities, fatalities among construction workers and the general public, and the increasing cost per accident, it can be argued that there is major scope for reversing the MVA trend in South Africa. Preliminary findings suggest that accidents that occur either on site or off-site are often due to H&S failures that could have being averted if, inter alia, the tenets of the

Construction Regulations were strictly upheld by the concerned parties (Emuze and Smallwood, 2012). The survey of the literature also indicates that inappropriate transportation of workers, overloading of vehicles, and mixed transportation are often causes of such MVAs.

Table 1 MVAs in South African construction from 2000 to 2011

Year	Accidents		Consequence (No.)	
	Percentage	No.	Fatality	Permanent Disability
2011	12.47	892	23	25
2010	10.85	984	63	57
2009	9.18	949	31	51
2008	8.35	910	31	30
2007	8.30	871	30	37
2006	6.95	629	34	29
2005	7.54	674	26	24
2004	7.66	624	28	26
2003	7.55	557	36	30
2002	8.15	561	33	29
2001	4.26	278	26	11
2000	3.59	264	15	11

Emuze and Smallwood (2012: 206)

LITERATURE REVIEW

The idea of conditional H&S and the notion that human behaviour is always influenced by systems issues beyond the control of workers are key H&S concepts underpinning MVA causation and prevention. This is perhaps valid as it is important to recognise that worker behaviour directly impact H&S outcomes, and that identifying critical behaviours such as precaution and controlling the systems involved, are valid methods to improve H&S performance outcomes (Mathis and Galloway, 2013). Such line of thinking has informed a number of MVAs or traffic studies.

In a recent study, Caroee and Singh (2012) examined different strategies adopted around the world to decrease the number of casualties in traffic. The study of these strategies addressed the different approaches, goals, and outcomes, and provided a comparison between the strategies, and a summary of best practices. Caroee and Singh (2012) noted that not only does 'Vision Zero' strategies decrease the number of people killed or seriously hurt in traffic, it also saves society money. The aim of 'Vision Zero' is to prevent traffic fatalities and people injured in traffic; it is not an attempt to prevent all accidents as it does improve road design, so if drivers follow the rules laid out by road designers, such as speed limits, seatbelts and not drinking and driving, then there will be no traffic fatalities or people seriously injured in traffic. Studies cited by Caroee and Singh (2012) determined that traffic accidents increase during construction times unless traffic rules are strictly enforced. However, they also

determined that traffic control and restraints can reduce traffic accidents. Therefore, the authors argued that a well-designed 'Vision Zero' for construction zones could be helpful to reach the goals of the vision.

However, compliance with regulations and legislation is reportedly sub-optimal in South Africa. That is, even if the government and the management of firms provide the minimum requirements to be met in terms of traffic and vehicular movement, the behaviour of workers is still critical to the achievement of zero MVAs. Othman (2012) conducted a study that researched the causes and effects of contractors' non-compliance with the Construction Regulations in South Africa and concluded that it appears that the importance of the regulations seems to have been overlooked. Othman (2012) noted that, inter alia, negligence and carelessness by labourers; lack of supervision; unskilled and uninformed workers, and lack of PPE constituted major sources of non-compliance. The net effects of these shortcomings are not limited to reduced productivity as well as increased injuries and fatalities.

Another USA based study that was reported in 1997 shows that construction workers were twice as likely to be killed by a motor vehicle; injury prevention efforts in construction have had limited effect on motor vehicle-related deaths, with death rates falling by only 11% during a 13-year period (1980-1992); construction accounts for more than one-fourth of all pedestrian deaths; and these pedestrian fatalities were mostly flaggers or surveyors (Ore and Fosbroke, 1997). As the leading cause of traumatic death in construction, exceeded only by falls, Ore and Fosbroke (1997) argued that the prevention of work-related motor vehicle research should become a greater priority in the construction industry. While this particular argument was made as far back as 1997, MVAs related studies have not enjoyed prominence in construction management related research in South Africa even as MVAS have been cited as a major cause of pedestrian injuries and fatalities in the country (Hobday and Knight, 2010). A focused review of the construction plant and equipment management research of Edwards and Holt (2009) also shows that MVAs have not gathered enough attention since it was missing from the H&S related discussions that were reported upon in terms of plant and equipment in construction.

METHODOLOGY

The preliminary literature review led to an exploratory quantitative survey that was conducted among all 62 medium and large sized general contractor members of the East Cape Master Builders Association (ECMBA) as categorised by the ECMBA, which constitutes an employer association for, inter alia, building contractors based and or operating in various cities and towns in the Eastern Cape Province of the Republic of South Africa. Although, only 15 responses were received and included in the analysis of the data, the pilot nature of the study at this stage mandates a future rigorous empirical study. Thus, the response rate of 24.2% realised for the pilot survey was deemed acceptable. It should be noted that two follow up communications were made in an endeavour to enhance the response rate. It is envisaged that the findings of this pilot survey will further inform future studies that are anticipated to use a mixed method approach.

In this pilot survey, the self-administered questionnaire that was delivered per e-mail consisted of 10 questions, 4 of which were 5-point Likert scale type questions. Due to the sensitive nature of the subject, demographic questions were not included, despite assurances of anonymity. The limited number of responses inferred that only

descriptive statistics in the form of percentages and mean scores could be computed for the presentation of the findings.

RESULTS OF THE PILOT SURVEY

When asked if they transported workers to and from and between construction sites, 93.3% of the respondents affirmed that their organisations did. Furthermore, all the firms (100%) used light delivery vehicles (LDVs) referred to as 'pickup' trucks in the USA, and 57.1% used flatbed trucks for transporting their workers. Whereas 40% of respondents' organisations simultaneously transport materials, plant and equipment, and workers; 60% do not. Of those that do, 83.3% used LDVs, and 16.7% used flatbed trucks. However, the analysis of the data shows that 26.7% of respondents' organisation's vehicles have been involved in accidents while transporting workers, 25% of which had had one accident, and 75% had had two accidents. In terms of incidence, those that had experienced two accidents had all experienced them over a period of five years, and the other organisation had experienced the one accident in 21 years. The accidents resulted in the following injuries: 1 fatality; 2 temporary disablements, and 2 medical-aid injuries. LDVs were involved in all (100%) the accidents. When asked if there is a need for a specially adapted construction vehicle to transport workers, 60% of respondents indicated yes, 20% indicated no, and 20% were unsure. Similarly, 33.3% of the respondents indicated that there is a need for a specially adapted construction vehicle to transport materials, plant and equipment, and workers, 40% indicated no, and 26.7% were unsure. A further 3 main likert scale types questions were asked based on the issues gleaned from the literature.

In this context, Table 1 indicates the extent of exposure or vulnerability of five categories of personnel to MVAs in terms of percentage responses to a scale of 1 (minor) and 5 (major), and a mean score (MS) between 1.00 and 5.00. It is notable that 2 (40%) of the categories have MSs > 3.00, which indicates that in general, the exposure is deemed major as opposed to minor, whereas in the case of those 3 (60%) categories which have MSs ≤ 3.00, the exposure is deemed minor. It is notable that general workers are the only category of worker that has a MS > 3.00. However, the MS of 2.93 for semi-skilled workers is marginally below 3.00. In terms of the various ranges, only (20%) first ranked drivers / operators has a MS > 3.40 ≤ 4.20, which indicates that the extent of exposure or vulnerability is between moderate to near major / near major.

Table 1: Extent of exposure or vulnerability of various categories of personnel to MVAs

Category	Unsure	Minor……Major					MS	Rank
		1	2	3	4	5		
Drivers / Operators	6.7	6.7	13.3	26.7	26.7	20.0	3.43	1
General workers	0.0	26.7	6.7	20.0	20.0	26.7	3.13	2
Semi-skilled workers	0.0	20.0	13.3	33.3	20.0	13.3	2.93	3
Skilled workers	0.0	20.0	40.0	13.3	13.3	13.3	2.60	4
Site management (supervisors, foremen)	0.0	42.9	14.3	28.6	7.1	7.1	2.21	5

Thereafter, those categories ranked second and third have MSs > 2.60 ≤ 3.40, which indicates that the extent of exposure or vulnerability is between near minor to moderate / moderate. Included in this range are general workers and semi-skilled workers. The categories ranked fourth and fifth, namely skilled workers and site management (supervisors, foremen) have MSs > 1.80 ≤ 2.60, which indicates that the extent of exposure or vulnerability is deemed between minor to near minor / near minor. However, the MS of skilled workers is on the upper end of the range, namely 2.60.

Table 2 indicates the extent fourteen unsafe transport / traffic practices contribute to the occurrence of accidents in South African construction in terms of percentage responses to a scale of 1 (minor) and 5 (major), and a MS between 1.00 and 5.00.

Table 2: Extent unsafe transport / traffic practices contribute to the occurrence of MVAs in South African construction

Practice	Unsure	Minor……Major					MS	Rank
		1	2	3	4	5		
Overloading of vehicles	7.1	7.1	0.0	14.3	7.1	64.3	4.31	1
Non-roadworthiness of vehicles / unsafe vehicles	14.3	7.1	7.1	7.1	14.3	50.0	4.08	2
Workers sitting on sides / or beds of vehicles	6.7	6.7	0.0	20.0	20.0	46.7	4.07	3
Worn tyres	6.7	13.3	6.7	13.3	26.7	33.3	3.64	4
Misjudgement / disregarding traffic control	21.4	0.0	21.4	7.1	28.6	21.4	3.64	5
Workers mounting / dismounting vehicles in motion	7.1	7.1	14.3	21.4	14.3	35.7	3.62	6
Inattentive driving of vehicles	21.4	7.1	7.1	21.4	21.4	21.4	3.55	7
Loss of vehicle control due to driver tiredness	28.6	7.1	28.6	7.1	14.3	14.3	3.00	8
Loss of vehicle control due to unsecured loads	7.1	28.6	0.0	28.6	28.6	7.1	2.85	9
Loss of vehicle control due to alcohol abuse	35.7	14.3	7.1	28.6	7.1	7.1	2.78	10
Loss of vehicle control due to adverse weather	20.0	13.3	26.7	13.3	20.0	6.7	2.75	11
Loss of vehicle control due to brake failure	21.4	21.4	21.4	14.3	7.1	14.3	2.64	12
Lack of adequate construction site signage	28.6	14.3	35.7	14.3	7.1	0.0	2.20	13
Loss of vehicle control due	42.9	28.6	7.1	14.3	0.0	7.1	2.13	14

to drug abuse

It is notable that 7 (50%) of the practices have MSs > 3.00, which indicates that in general, the extent to which they contribute is deemed major as opposed to minor, whereas in the case of the other 7 (50%) categories which have MSs ≤ 3.00, the exposure can be deemed minor. It should be noted that the MS of 'loss of vehicle control due to driver tiredness' falls on the midpoint of the range 3.00. Furthermore, the high level of 'unsure' responses is notable.

In terms of the various ranges, only first ranked 'overloading of vehicles' has a MS > 4.20 ≤ 5.00, which indicates that the extent is deemed between near major to major / major. This is notable as literature and anecdotal evidence inform that overloading of vehicles often contribute to the occurrence of accidents in South African construction. The practices (42.9%) ranked second to seventh have MSs > 3.40 ≤ 4.20, which indicates that the extent is deemed between moderate to near major / near major. Two practices are vehicle related, namely 'non-roadworthiness of vehicles / unsafe vehicles' and 'worn tyres'; two are load related, namely 'workers sitting on sides / or beds of vehicles' and 'workers mounting / dismounting vehicles in motion', and two are driver related, namely 'misjudgement / disregarding traffic control' and 'inattentive driving of vehicles'. The five practices (35.7%) ranked eighth to twelfth have MSs > 2.60 ≤ 3.40, which indicates that the extent is deemed between near minor to moderate / moderate. These include 'loss of vehicle control due to driver tiredness', 'unsecured loads', 'alcohol abuse', 'adverse weather', and 'brake failure'. In essence, four (80%) of the five are driver related, and one (20%) load related, which could also be construed to be driver related. The two (14.3%) practices ranked thirteenth and fourteenth have MSs > 1.80 ≤ 2.60, which indicates that the extent is deemed between minor to near minor / near minor. One is street furniture related, namely 'lack of adequate construction site signage' and the other is driver related, namely 'loss of vehicle control due to drug abuse'.

Table 3 indicates the extent five contributors exacerbate the injuries incidental to MVAs in South African construction in terms of percentage responses to a scale of 1 (minor) and 5 (major), and a MS between 1.00 and 5.00. It is notable that four (80%) of the practices have MSs > 3.00, which indicates that in general, the extent to which they exacerbate the injuries incidental to MVAs is deemed major as opposed to minor, whereas in the case of the one category which has a MS ≤ 3.00, the extent can be deemed minor. The high level of 'unsure' responses is once again notable. In terms of the various ranges, only first ranked 'lack of secured seats' has a MS > 4.20 ≤ 5.00, which indicates that the extent is deemed between near major to major / major.

The problem relative to MVAs in the course of construction is that workers are generally transported while not seated in secured seats. Furthermore, if they are seated then they are not availed of seat belts – 'lack of seat belts' is ranked second, which along with 'non-wearing of seat belts', and 'lack of roll over protection' have MSs > 3.40 ≤ 4.20, which indicates that the extent is deemed between moderate to near major / near major. 'Non-wearing of seat belts' and 'lack of roll over protection' are contributors frequently cited in South African literature, particularly the latter, which applies when workers are being transported on the back of flatbed trucks or pickups. 'Lack of pre-start up inspections', ranked fifth has a MS > 2.60 ≤ 3.40, which indicates that the extent is deemed between near minor to moderate / moderate.

Table 4 indicates the extent incidents eventuate due to MVAs in South African construction in terms of percentage responses to a scale of 1 (minor) and 5 (major), and a MS between 1.00 and 5.00. It is notable that only 3 (30%) of the incidents have MSs > 3.00, which indicates that in general, the extent to which they eventuate is deemed major as opposed to minor, whereas in the case of the other 7 (70%) categories which have MSs ≤ 3.00, the extent is deemed minor. The high level of 'unsure' responses is once again notable.

Table 3: Extent contributors exacerbate the injuries incidental to MVAs in South African construction

Contributor	Unsure	Minor……Major					MS	Rank
		1	2	3	4	5		
Lack of secured seats	20.0	0.0	6.7	6.7	26.7	40.0	4.25	1
Lack of seat belts	21.4	0.0	7.1	7.1	35.7	28.6	4.09	2
Non-wearing of seat belts	13.3	0.0	6.7	20.0	20.0	40.0	4.08	3
Lack of roll over protection	20.0	6.7	13.3	13.3	26.7	20.0	3.50	4
Lack of pre-start up inspections	21.4	21.4	7.1	28.6	21.4	0.0	2.64	5

Table 4: Extent incidents eventuate due to MVAs in South African construction

Incident	Unsure	Limited……Always					MS	Rank
		1	2	3	4	5		
Fall from vehicle in motion while getting on / off	13.3	6.7	6.7	26.7	33.3	13.3	3.46	1
Fall from vehicle in motion	26.7	0.0	13.3	20.0	33.3	6.7	3.45	2
Collision with other vehicles	14.3	14.3	14.3	14.3	35.7	7.1	3.08	3
Collisions between vehicle and other equipment	21.4	0.0	35.7	14.3	28.6	0.0	2.91	4
Crunched / run-over by highway vehicle	42.9	7.1	28.6	14.3	0.0	7.1	2.50	5
Crunched / run-over by manoeuvring vehicle	28.6	28.6	28.6	14.3	0.0	0.0	1.80	6
Worker struck by vehicle exiting work area	21.4	57.1	7.1	0.0	14.3	0.0	1.64	7
Worker struck by vehicle	21.4	57.1	14.3	0.0	7.1	0.0	1.45	8

entering work area								
Worker struck by vehicle inside work area	14.3	64.3	14.3	0.0	7.1	0.0	1.42	9
Crunched / run-over by vehicle entering the site	21.4	50.0	28.6	0.0	0.0	0.0	1.36	10

Only the first two (20%) ranked incidents have MS > 3.40 ≤ 4.20, which indicates that the extent is deemed between moderate to near major / near major. 'Fall from vehicle in motion while getting on / off' and 'fall from vehicle in motion' are also frequently cited in South African literature. 'Collision with other vehicles' and 'Collisions between vehicle and other equipment', which have MSs > 2.60 ≤ 3.40, indicate that the extent is deemed between near minor to moderate / moderate. Fifth ranked 'crunched / run-over by highway vehicle' has a MS > 1.80 ≤ 2.60, which indicates that the extent is deemed between minor to near minor / near minor. The incidents (50%) ranked sixth to tenth have MSs > 1.00 ≤ 1.80, which indicates that the extent is deemed between minor to near minor. The low MSs relative to 'crunched / run-over by manoeuvring vehicle', the three 'worker struck by vehicle exiting, entering, and inside work area' and 'crunched / run-over by vehicle entering the site' indicates that the incidents eventuating due to MVAs occur on the public roads as opposed to on site or in proximity thereto.

DISCUSSION AND CONCLUDING REMARKS

The respondent contractors use LDVs and flatbed trucks to transport workers to and from, and between construction sites. A percentage of these contractors also simultaneously transport materials, plant and equipment, and workers. Therefore, it can be concluded that workers are at risk and the incidence of MVAs in the course of construction is unlikely to reduce till such time that a strategy is evolved and appropriate interventions taken. This conclusion is underscored by the finding that 26.7% of respondents' organisations had experienced such accidents. All categories of personnel are exposed to and vulnerable to MVAs, but more so drivers / operators, and general workers. The literature leads to the conclusion that MVAs in the course of employment are a universal problem and reflect the general road safety status quo.

A range of unsafe transport / traffic practices contribute to the occurrence of MVAs in South African construction. However, based upon the responses it can be concluded that the 'overloading of vehicles' is attributable to the simultaneous conveyance of materials, plant and equipment, and workers. Furthermore, 'workers sitting on sides / or beds of vehicles' and 'workers mounting / dismounting vehicles in motion' have their origin in the conveyance of workers on inappropriate vehicles. It can also be concluded that vehicle related practices such as 'non-roadworthiness of vehicles / unsafe vehicles' and 'worn tyres' contribute substantially. Then a range of driver related practices contribute to a varying extent. Therefore, in summary, load, vehicle condition, and driver practices all contribute. The findings relative to the extent contributors exacerbate the injuries incidental to MVAs, namely 'lack of secured seats', 'lack of seat belts', 'non-wearing of seat belts', and 'lack of roll over protection' further point to the conveyance of workers on inappropriate vehicles.

'Fall from vehicle in motion while getting on / off' and 'fall from vehicle in motion' in terms of the extent incidents eventuate due to MVAs further point to the

conveyance of workers on inappropriate vehicles. Contractors should thus deliberate the practice of conveying workers on inappropriate vehicles. This recommendation is reinforced by 60% of the respondents who indicated that there is a need for a specially adapted construction vehicle to transport workers. Although, only 33.3% of respondents indicated that there is a need for a specially adapted construction vehicle to transport materials, plant and equipment, and workers, and 40% indicated no, 26.7% were unsure. Therefore, it is recommended that contractors deliberate the practice of simultaneously transporting materials, plant and equipment, and workers as they are different in terms of characteristics and fragility. In terms of driver practices, and the management of loads it is recommended that: drivers be subjected to 'refresher' driver training; pre-driving inspection schedules and processes be implemented; safe load transportation procedures be implemented, and a driver substance abuse programme be implemented. Having said this, it important to note that this research project is yet to reach maturity as a comprehensive data and subsequent analysis is needed for designing effective strategies, setting achievable goals, ranking actions, and checking the effectiveness of the strategies. Thus, future studies would draw on lessons learnt so far in order to propose remedial strategies for the use of the stakeholders in South African construction. The implication of the literature reviewed (Emuze and Smallwood, 2012) and the preliminary empirical data is that MVAs and their attendant effects will continue to plague South African construction if suitable interventions are not implemented. The significance of the study is that the minimisation of the direct and indirect costs of MVA related accidents has reached a 'tipping point', which requires a multi stakeholder solution.

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